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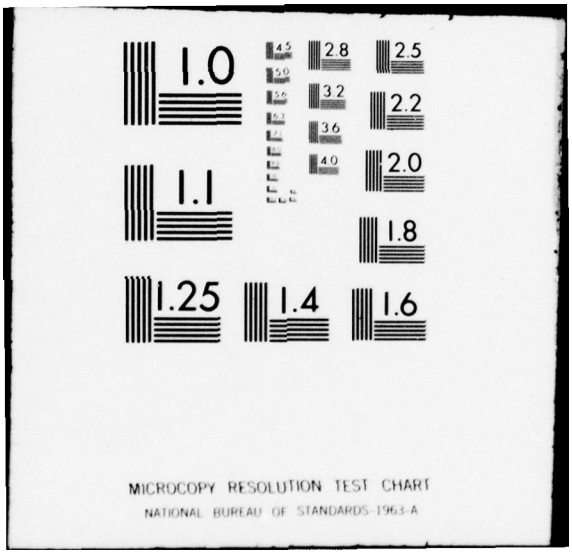
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REPORT NO. CG-B-005-78

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FUEL SYSTEM STANDARD TEST PROCEDURE

U.S. Coast Guard Office of Boating Safety
Boating Technical Division
2100 2nd Street SW
Washington, D. C. 20590

January 1978
Final Report

PREPARED FOR

U.S. DEPARTMENT OF TRANSPORTATION
UNITED STATES COAST GUARD
WASHINGTON, D.C. 20590

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LEVEL II

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16. Abstract

The purpose of this test procedure is to specify a method that is acceptable to the United States Coast Guard and the equipment to be used in determining whether or not a particular fuel system component is in compliance with the Gasoline Fuel System Standard in Subpart J of Part 183 of Title 33, Code of Federal Regulations.

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METRIC CONVERSION FACTORS

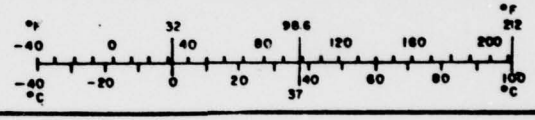
Approximate Conversions to Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
in	inches	*2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
		AREA		
in^2	square inches	6.5	square centimeters	cm^2
ft^2	square feet	0.09	square meters	m^2
yd^2	square yards	0.8	square meters	m^2
mi^2	square miles	2.6	square kilometers	km^2
	acres	0.4	hectares	ha
		MASS (weight)		
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2000 lb)	0.9	tonnes	t
		VOLUME		
tsp	teaspoons	5	milliliters	ml
Tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	l
pt	pints	0.47	liters	l
qt	quarts	0.95	liters	l
gal	gallons	3.8	liters	l
ft^3	cubic feet	0.03	cubic meters	m^3
yd^3	cubic yards	0.76	cubic meters	m^3
		TEMPERATURE (exact)		
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

*1 in = 2.54 (exactly). For other exact conversions and more detailed tables, see NBS Misc. Publ. 286, Units of Weights and Measures, Price $2.25, SD Catalog No. C13.10:286.

Approximate Conversions from Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi
		AREA		
cm^2	square centimeters	0.16	square inches	in^2
m^2	square meters	1.2	square yards	yd^2
km^2	square kilometers	0.4	square miles	mi^2
ha	hectares (10,000 m^2)	2.5	acres	
		MASS (weight)		
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	tonnes (1000 kg)	1.1	short tons	
		VOLUME		
ml	milliliters	0.03	fluid ounces	fl oz
l	liters	2.1	pints	pt
l	liters	1.06	quarts	qt
l	liters	0.26	gallons	gal
m^3	cubic meters	35	cubic feet	ft^3
m^3	cubic meters	1.3	cubic yards	yd^3
		TEMPERATURE (exact)		
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F



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NOTE

Due to editorial changes some lines, paragraphs, and paragraph numbers normally in sequential order have been omitted from these test procedures.

1.0 SCOPE

1.1 Applicability of Federal Boat Safety Act -- The Gasoline Fuel Systems Standards Test Procedures and the regulations to which they apply were issued under the authority of the Federal Boat Safety Act of 1971. "Boat" as it is defined in the Act includes any vessel:

a. Manufactured or used primarily for noncommercial use;
b. Leased, rented or chartered to another for the latter's non-commercial use; or
c. Engaged in the carrying of six or fewer passengers.

1.2 Exceptions -- The Federal Boat Safety Act of 1971 applies to all boats used on waters subject to the jurisdiction of the United States and on the high seas beyond the territorial seas for vessels owned in the United States except:

a. Foreign vessels temporarily using waters subject to United States jurisdiction;
b. Military or non-recreational public vessels of the United States;
c. Ship's lifeboats; and
d. A vessel whose owner is a State or subdivision thereof, which is used principally for governmental purposes and which is clearly identifiable as such.

1.3 Applicability of Gasoline Fuel Systems Standard -- The Gasoline Fuel System Standard for boats and associated equipment, which appears in Subpart J of Part 183 of Title 33, Code of Federal Regulations applies to all boats that have gasoline engines for electrical or mechanical power or propulsion, except boats that have outboard engines only.

2.0 PURPOSE -- The purpose of this test procedure is to specify a method that is acceptable to the United States Coast Guard and the equipment to be employed in determining whether or not a particular fuel system component is in compliance with the Gasoline Fuel System Standard in Subpart J of Part 183

of Title 33, Code of Federal Regulations.

3.0 GLOSSARY OF TERMS

3.1 Actual Installation -- An actual installation is defined as either: (1) the configuration from which a component or system was removed in order to accomplish the test; or (2) the configuration for which a component or system is intended to be used.

3.2 Adhesive Bonding -- The fastening together of two or more solids by the use of glue, cement or other adhesive.

3.3 BDC -- Bottom Dead Center.

3.4 Blow Back -- An actual back flow of liquid gasoline out of the deck fill fitting and past the fuel nozzle, in such a quantity as to leave no doubt that the system failed. Fumes and spray mist shall not be construed as a failure since these are found in all systems during filling operations.

3.5 BTDC -- Before Top Dead Center.

3.6 CC -- Cubic centimeter = 1 ml

3.7 CFR -- Code of Federal Regulations

3.8 Cohesive Strength -- Strength corresponding to cohesive forces between atoms.

3.9 CO_2 -- Carbon Dioxide

3.10 Electric Fuel Pump -- A pump whose operation is dependent only on a self-contained electric motor and as such does not have to be mounted directly to the engine.

3.11 Flat Bottom Tank -- A tank with either square or rounded corners, but having a major portion of the bottom side forming or lying in a flat, horizontal plane.

3.12 Fuel System -- All of the fuel system up to but not including the carburetor, i. e. fill and vent hoses, fuel tank(s), distribution lines, valves, fuel pump, fuel filter, and carburetor inlet hard line.

3.13 g -- Unit of acceleration equal to the standard acceleration of gravity. 1 g = 32.174 ft(9.81 m) per sec. per sec.).

3.14 GN_2-- Gaseous Nitrogen

3.15 Leak Detection Solution -- A solution formulated especially for detecting leaks through the formation of bubbles that is compatible with the system being tested (non-corrosive, non-toxic, etc.).

3.16 Mechanical Fuel Pump -- A pump whose operation depends solely on the rotation of an engine to provide its power, and has a direct mechanical link between itself and the engine for such transfer.

3.17 ms -- Milliseconds. 1 ms = 0.001 sec.

3.18 NC -- Normally closed - the position a valve is in when control power or pressure is not being supplied.

3.19 PSIG -- Pounds per square inch is the pressure above atmospheric pressure.

3.20 Rated Capacity -- The capacity of a tank in U. S. gallons as specified on the fuel tank label according to section 183.514.

3.21 Safe the Area -- As used in this procedure, to "safe" an area shall mean to reduce all pressures to zero psig, to disconnect or shut-off any power supply, to remove any dangerous fluids or gases, or to accomplish any other act after a test which would help restore the test area to a normal safe status.

3.22 SCC/S -- Standard cubic centimeters per second.

3.23 Secure the Test Setup -- Remove test equipment, hoses, fittings and adapters, and restore the test component to its original configuration.

3.24 Test Equipment -- All equipment such as pressure supply hoses, gauges, and fittings, which are required to perform the test but are not part of the actual system under test.

3.25 Typical Installation -- A typical installation is a configuration which could reasonably be expected in an actual installation (see Test Schematic).

3.26 Zero Leakage -- Any leakage which cannot be detected by the naked eye using a leak detection solution (approximately 10^{-4}SCC/S).

4.0 TEST PROCEDURE

4.1 General Description -- The component to be tested shall be visually inspected upon receipt. All identifying data shall be noted and documented such as manufacturer, date of manufacture, model number, serial number, capacity, test conditions, general condition and any other observations which would be pertinent to the test.

4.2 Test Conditions

4.2.1 Test Article Identification.-- The test article shall be identified with a test number immediately upon receipt at the test facility. This identification shall be marked on or attached to the test article for the duration of the testing process. As a minimum, the following photographs shall be taken:

a. An as installed view or views, if possible;
b. Close-up views of individual components of the system;
c. A view of the total system as received for test; and
d. A view of the test configuration.

4.2.2 Personnel -- A minimum of two (2) people shall be required to perform the test and adequately monitor and document the results. In addition to these two people, two additional people may be required for safety and proper verification of the test.

1. Test Engineer
2. Technician
3. Quality Assurance Inspector (may only be required part time)
4. Safety Monitor

4.2.3 Storage and Handling -- All test components shall be handled in accordance with the manufacturer's requirements, if specified, or in accordance with accepted industry practices and standards. In no event shall the item be stacked, carried or dropped or otherwise mishandled such that the results of the subsequent testing could be altered. All test components shall be stored in accordance with the manufacturer's requirements with respect to time, temperature, humidity, etc. If no requirements are specified, normal conditions consistent with prudent engineering judgement shall be utilized.

4.3 Safety Requirements -- The following safety related items are recommended as minimum requirements to ensure the performance of a safe test to both equipment and personnel:

1. The test area should be adequately vented, preferably outside, but protected from high wind, etc.
2. The test area should be located such that access by unauthorized personnel can be prevented.
3. Test personnel should position themselves no closer than is necessary for performance of the test.
4. Test personnel should wear protective glasses.
5. A safety monitor should stand by at a safe distance with a fire extinguisher ready to assist should an emergency occur.
6. No smoking shall be allowed in the test area.
7. An adequate pressure relief system should be utilized and proper operation verified prior to the test.
8. Adequate precautions relating to high pressure propane, air supply and mixing chamber shall be observed.
9. Any company, local, State or Federal rules, regulations or laws shall take precedence over any of the above and shall be in addition to the above.

4.4 Receiving Inspection -- Immediately upon receipt, or as soon as possible thereafter, the test component or system shall be subjected to an inspection. The inspection shall consist of at least the following items being observed

1. Date received
2. Name of component or system and quantity
3. Manufacturer
4. Date of manufacture
5. Model number
6. Serial number
7. Capacity, rating, or any other useful information observed
8. Shipping or transport damage
9. Quality of workmanship
10. Conformity to manufacturer's documentation and maintenance manuals
11. Dents, dings, abrasions; loose or missing screws, bolts, clamps, B-nuts; other defects (not attributable to shipping) noted

12. Proper identification in accordance with Paragraph 4.2.1 of this procedure

13. Inventory list to include any and all equipment items received as a part of this test procedure.

Any discrepancies noted above shall be documented and, if possible, photographed for a permanent record.

LAB EXAMINATIONS

5.0 LAB EXAMINATION NO. 1 -- FOAM SPECIFICATION FOR ENCASING METAL TANKS

183.516 Cellular plastic used to encase fuel tanks

(a) Cellular plastic used to encase metallic fuel tanks must—

(1) Not change volume by more than five percent or dissolve after being immersed in any of the following liquids for 24 hours at 29° C:

(i) Reference fuel B ASTM D-471, dated December 18, 1968.

(ii) No. 2 reference oil of ASTM D-471, dated December 18, 1968.

(iii) Five percent solution of trisodium phosphate in water; and

(2) Not absorb more than 0.12 pound of water per square foot of cut surface, measured under Military Specification MIL P-21929B, dated June 22, 1970.

(b) Non-polyurethane cellular plastic used to encase metallic fuel tanks must have a compressive strength of at least 60 pounds per square inch at ten percent deflection measured under ASTM D-1621, "Compressive Strength of Rigid Cellular Plastics", dated August 31, 1964.

(c) Polyurethane cellular plastic used to encase metallic fuel tanks must have a density of at least 3.2 pounds per cubic foot, measured under ASTM D-1622, "Apparent Density of Rigid Cellular Plastics", dated September 30, 1963.

NOTE

The volume change in paragraph (a)(1) can be measured as specified under ASTM D-1622.

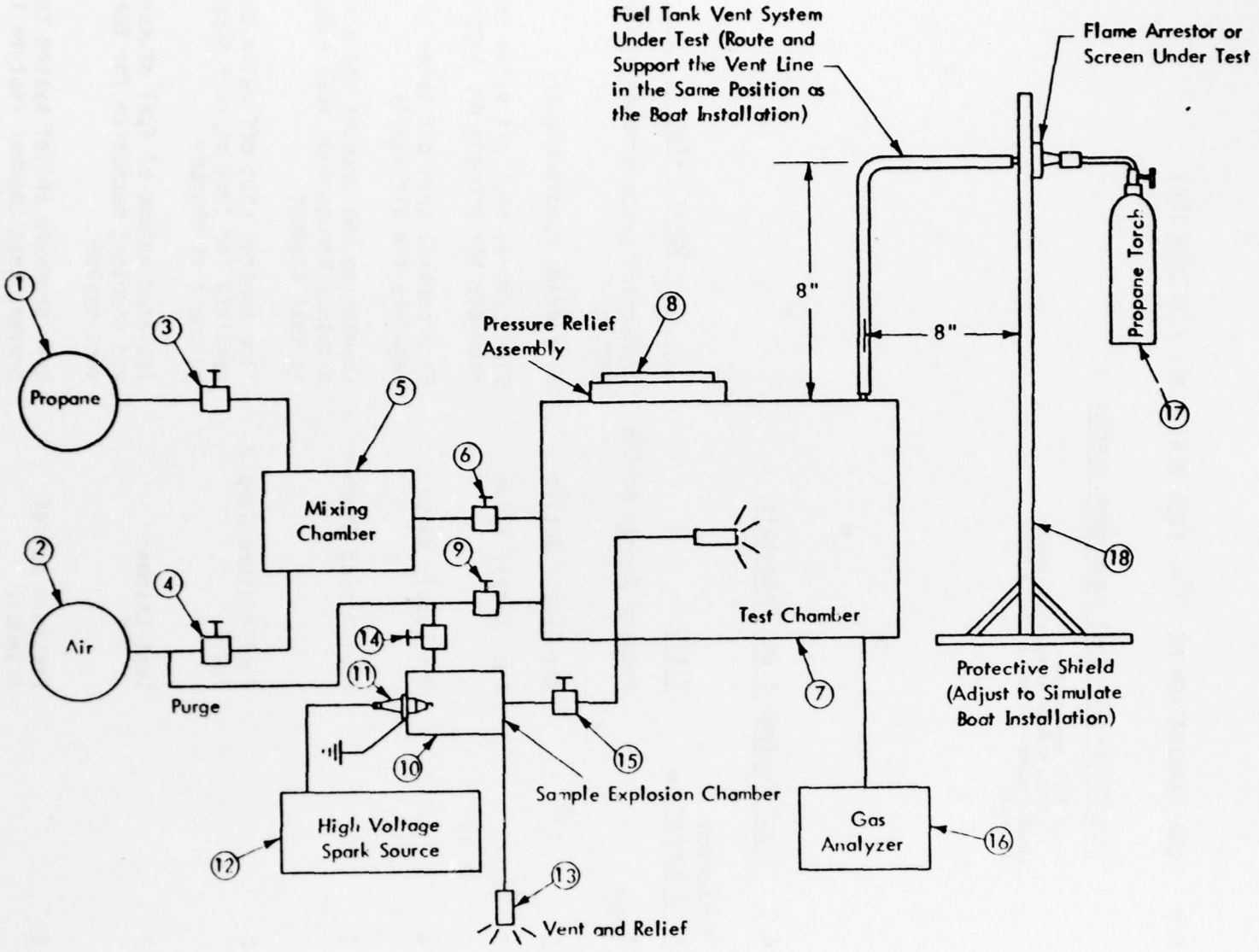
6.0 LAB EXAMINATION NO. 2 -- FUEL VENT FLAME ARRESTOR TEST

183.520(b)(1) Fuel tank vent system

(b) Each vent must—
(1) Have a flame arrester that can be cleaned unless the vent is itself a flame arrestor;

6.1 Test Equipment and Materials

Component Find Number	Title	Description
1	Propane Supply Bottle	Commercial grade propane storage bottle
2	Air Supply Bottle	Shop grade compressed air
3	Fuel Supply Valve	Flow control shut off valve to regulate the propane gas supply
4	Air Supply Valve	Flow control shut off valve to regulate the air supply
5	Fuel Mixing Chamber	Chamber to mix propane and air to obtain a homogenious fuel supply in test chamber
6	Fuel Mixture Supply Valve	Flow control shut off valve to regulate the fuel mixture supply to the test chamber
7	Test Chamber	Isolated volume of fuel mixture and mounting mechanism for the test vent system
8	Pressure Relief Assembly	Over pressure relief system to prevent test chamber rupture in case of fuel mixture ignition
9	Purge Supply Valve	Flow control shut off valve to supply air to test chamber to obtain non-combustive atmosphere



TEST SCHEMATIC PROCEDURE

Component Find Number	Title	Description
10	Sample Explosion Chamber	Small volume chamber to verify that test chamber vapor is combustive
11	Spark Plug	Ignition source for detonating test chamber vapor sample
12	D. C. Power Supply	High voltage source for spark plug
13	Relief Valve	Over pressure relief mechanism to prevent sample explosion chamber rupture at sample vapor ignition
14	Isolation Valve	Flow control shut off valve for air purge of sample explosion chamber volume
15	Isolation Valve	Flow control shut off valve for test chamber vapor sample
16	Gas Analyzer	Hydrocarbon gas analyzer capable of determining the percentage of propane in air to an accuracy of +1% within the range of 0 to 10% propane by volume
17	Propane Torch	Test vapor ignition source
18	Blast Shield	Protective shield against test apparatus fragments in case of uncontrolled explosion of test chamber -- also serves as mounting support for the test vent system

6.2 Fuel Tank Vent Flame Arrestor Test

6.2.1 This procedure shall be used to perform a flame test on the vent system of the fuel tank. It will determine whether the flame arrestor, flame screen, and/or vent line will effectively prevent the passage of flame into the fuel tank.

6.2.2 Visually inspect the system to be tested.

6.2.3 Mount and secure the vent line and/or flame arrestor similar to an actual installation of the system or to a typical boat installation as shown in the test schematic, Paragraph 6.1. One end shall be mounted to a test chamber simulating a fuel tank. The other end shall be mounted to a protective shield simulating the boat.

a. If the system configuration is similar to an actual installation, measure the vertical distance between the top of the chamber and the exit of the vent, and the horizontal distance between the chamber vent and the exit of the vent.

6.2.4 Verify that all safety precautions are in effect and that the system and test personnel are ready for the test to start. Verify that a CO_2 or equivalent fire extinguisher is available.

6.2.5 Fill the test chamber with a mixture of propane and air. Verify the mixture is 4.75% $\pm$ 0.50% propane by volume using a gas analyzer or by an acceptable alternate method.

6.2.6 Increase and maintain the pressure in the test chamber between 0.3 and 1.0 psig, such that a very slight flow of the explosive mixture exhausts from the vent line during the entire test.

6.2.7 Adjust the flame of a standard propane torch (Grade HD-5 propane per NGPA Standards) with a pencil point burner to approximately 2.5 in. (6.4 cm).

6.2.8 Pass the flame slowly back and forth (approximately once each second) across the opening of the flame arrestor, screen or vent line for one minute.

CAUTION

The exhaust from the vent line may ignite. This should be expected and shall not invalidate the test or constitute a failure of the system.

6.2.9 Verify that the explosive mixture in the test chamber does not ignite by means of a visual observation, the use of a temperature or pressure transducer or by any other suitable means. If the mixture in the test chamber does ignite, the vent and/or flame arrestor shall be unacceptable. Discontinue the test and accomplish Paragraphs 6.2.12 and 6.2.13.

6.2.10 Ignite the mixture in the test chamber or ignite a sample of the mixture from the test chamber to verify that an actual explosive mixture existed.

6.2.11 Repeat the flame test again per Paragraphs 6.2.5 through 6.2.10.

6.2.12 Extinguish any flame that may exist at the flame arrestor or vent line with CO_2 or other suitable means.

6.2.13 Secure the test system as required and safe the area. Vent and purge the explosive mixture from the test chamber.

6.2.14 If the flame from the propane torch cause no ignition of the explosive mixture in the test chamber, the vent and/or flame arrestor shall be deemed acceptable according to the requirements of this procedure.

6.3 Overflow Test

183.520(b)(2) Fuel vent overflow test

(b) Each vent must—

(2) Not allow a fuel overflow at the rate of up to two gallons per minute to enter the boat.

6.3.1 Disconnect the vent hose from the fuel tank.

6.3.2 Connect the vent hose to a source of water with a 3 foot head above the vent outlet fitting with no more restriction than the attachment spud on the fuel tank.

6.3.3 If the water flow exceeds 2 gallons per minute restrict it to 2 gallons per minute.

6.3.4 Allow the water to run for one minute and determine whether any water enters the boat.

6.3.5 If any water enters the boat the location of the vent outlet is not in compliance with this paragraph.

7.0 LAB EXAMINATION NO. 3 -- FILL RATE TEST (9 gal/min)

183.522 and 183.564(a) Fuel fill overflow and blowback tests

§ 183.522 Fuel tank fill systems.

Fuel must not blow back through the fuel fitting when a tank is—

(a) Between one-fourth and three-fourths full; and

(b) Refueled at a rate of at least nine gallons per minute.

§ 183.564 Fuel tank fill system.

(a) Each fuel fill opening must be located so that a gasoline overflow of up to five gallons per minute for at least five seconds will not enter the boat when the boat is in its static floating position.

7.1 General Description -- The fuel fill system shall be tested after it has been installed in a boat as shown in the Test Schematic. When refueled at a flow rate of nine (9) gallons (34.1 l) per minute, there shall be no blow back of fuel through the fuel deck fill fitting. The fill line shall then be plugged and with a flow rate of 5 gal. (18.9 l) per minute, the configuration of the boat shall prevent any of the overflow from entering the boat.

7.1.1 Constraints

1. This test shall be accomplished only with the explicit knowledge and approval of the safety engineer.

2. While this test is identified as a fuel fill system test, the overflow section of the test is actually a verification of the boat configuration as it relates to the fill system. Thus, the system as validated in this installed condition shall be acceptable only on that boat model in the same configuration as it was tested.

7.1.2 Pre-Test Conditions and Assumptions

1. The complete fuel fill and storage system shall be installed as delivered by the manufacturer (all permanently installed items shall be in the test boat).

2. The system shall be empty of any gasoline and ready for testing.

3. Personnel performing the test shall be reasonably knowledgeable of boat systems and familiar with testing practices to accomplish the procedure without undue training required.

7.1.3 Test Media -- Standard pump gas (regular or ethyl) is required for the test of flowrate. Water may be used for testing for overflow.

7.1.4 Other -- For this test the boat shall be positioned in its normal unloaded static floating position as determined in the following manner:

1. Place the unloaded boat in the water. The "unloaded boat" shall contain all permanently installed items such as, but not limited to, engines, batteries, seats, and shall include engine oil and fuel to the designed capacity. The unloaded boat shall not contain such items as live loads, portable fuel tanks, paddles, PFDs, tool kits, ropes, flags, portable lights or other loose gear.

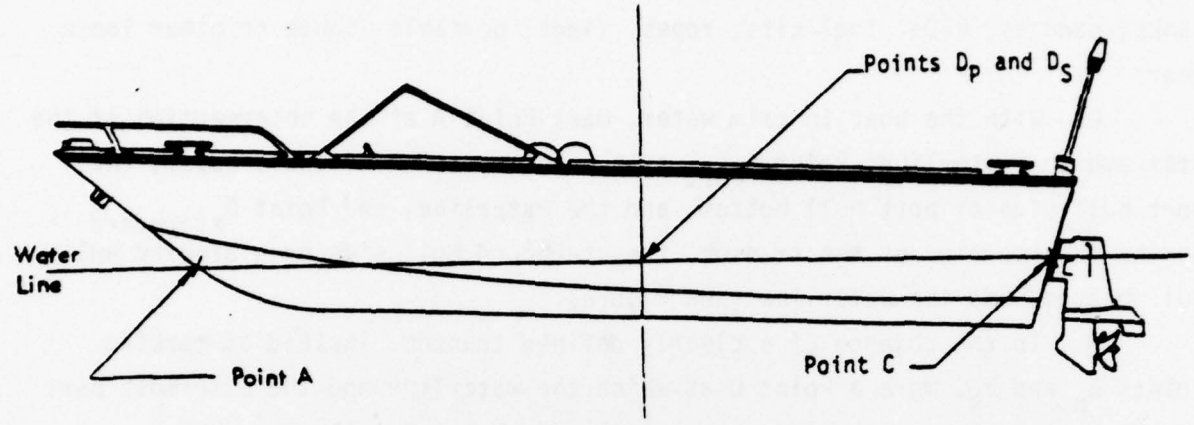
2. With the boat in calm water, mark Point A at the intersection of the stem and the waterline, Point B_{port} at the intersection of the transom, the port hull side or port hull bottom, and the waterline, and Point $B_{starboard}$ at the intersection of the transom, the starboard hull side or starboard hull hull bottom, and the waterline (see Figure).

3. In the absence of a clearly defined transom, instead of marking Points B_p and B_s, mark a Point C at which the waterline and the aftermost part of the boat in the water intersect, similar to Point A in Paragraph 2 above. Also, at some convenient plane perpendicular to the longitudinal axis, mark Points D_{port} and $D_{starboard}$ where the port and starboard hulls intersect the waterline (See Figure).

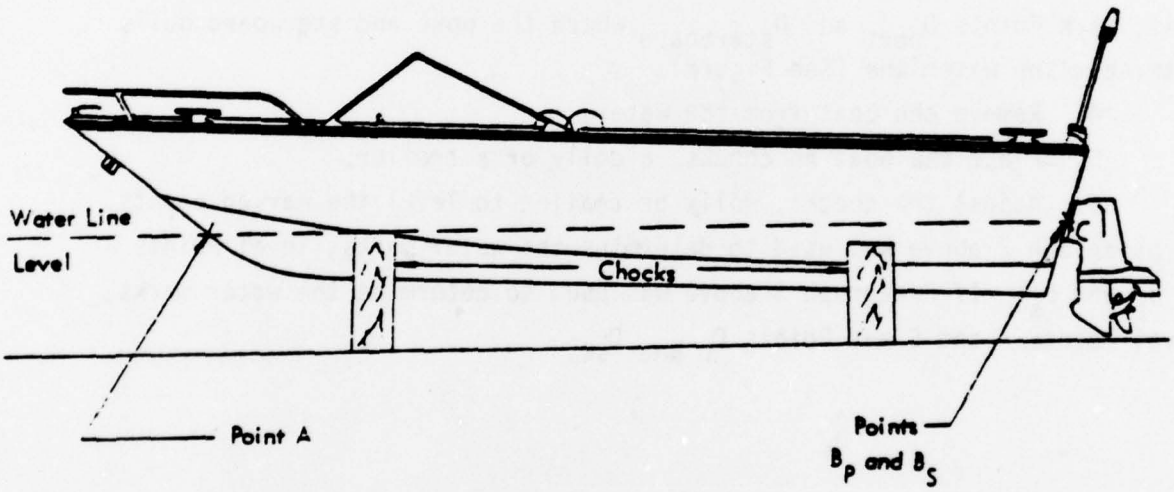
4. Remove the boat from the water.

5. Place the boat on chocks, a dolly or a trailer.

6. Adjust the chocks, dolly or trailer to level the marked points. If paragraph 2 above was used to determine the water marks, level Points A, B_p and B_s. If Paragraph 3 above was used to determine the water marks, level Points A and C and Points D_p and D_s.



TEST CONDITION (PARAGRAPH 3)



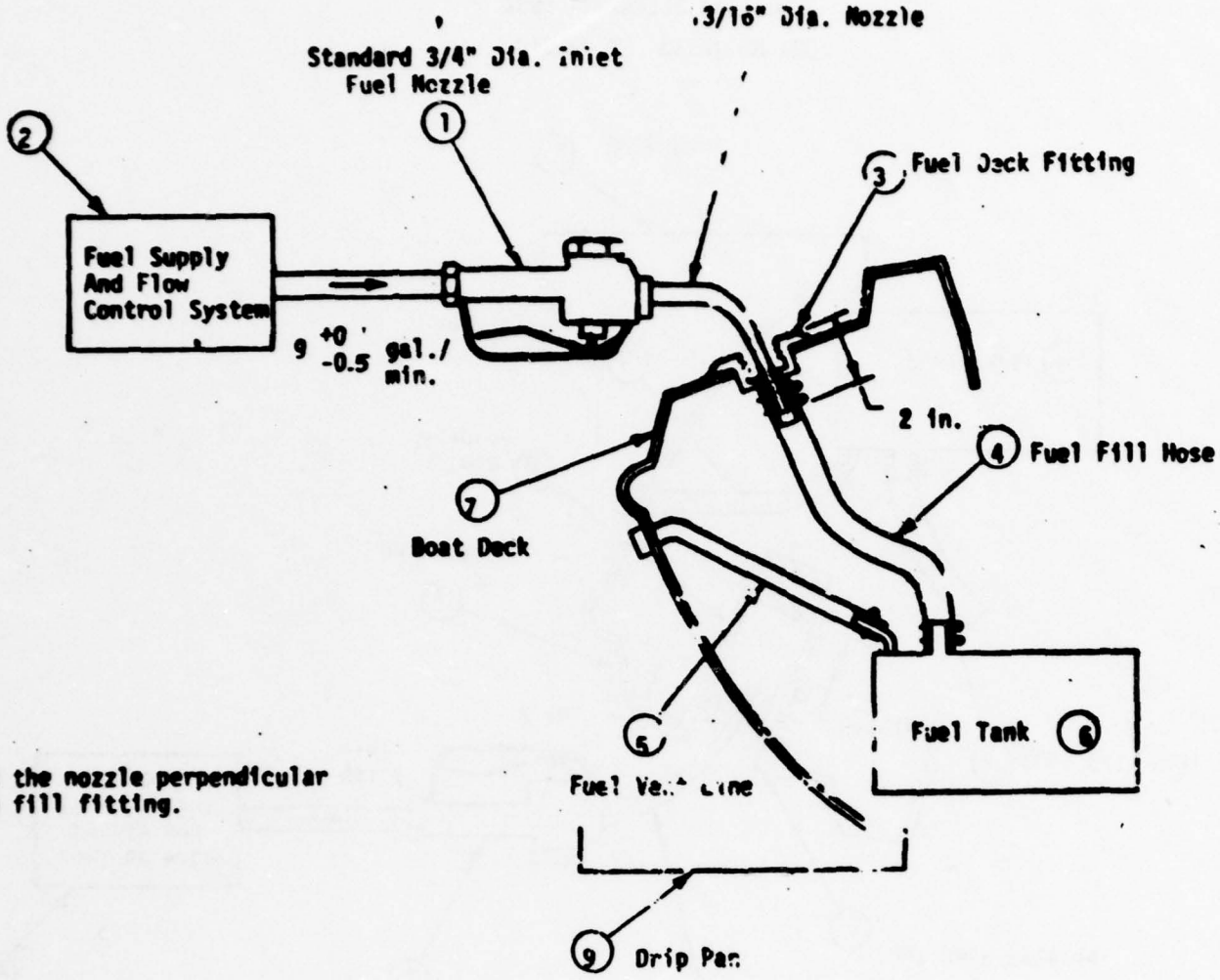
NORMAL TEST CONDITION (PARAGRAPH 2)

FIGURE A. DETERMINATION OF NORMAL UNLOADED STATIC FLOATING CONDITION

7.2 Test Equipment and Schematic

Component Find No.	Title	Description
1	Fuel Nozzle	Standard fuel nozzle with 3/4 in. (1.9 cm) diameter inlet and 13/16 in. OD (2.1 cm) diameter nozzle capable of flowing at least 9 gals. (34.1 l) per minute
2	Fuel Supply and Control System	A supply of ordinary pump gasoline (regular or ethyl) sufficient to accomplish the blow back test and allowance for any calibration of equipment. The control system may be of any design to give the required 8.5 to 9 gal./min. (32.2 to 34.1 l/min.) and 5±½ gal./min. (18.9±0.9 l/min.) for the test (from simple inexpensive preset hand valves to more expensive flow-controllers).
3	Fuel Deck Fitting	A fitting which attaches to the deck of the boat and to which the fuel fill hose from the tank attaches on the underside.
4	Fuel Fill Hose	A gasoline hose which connects the deck fitting to the fuel tank (approximately 1½ in. [3.8 cm] diameter).
5	Fuel Vent Line	A gasoline hose which connects the fuel tank to the atmosphere. It allows proper venting of the tank during filling and maintains atmospheric pressure in the tank during engine operation (approximately ½ in. [1.3 cm] diameter).
6	Fuel Tank	A storage resevoir for gasoline usually having a capacity of 12 gal. (45.4 l) or more.
7	Boat Deck	As used in this procedure the part of the boat where the fuel fill is mounted.
8	Test Adapter	A special test assembly consisting of a length (approximately 10 in. [0.3 m]) of fuel fill hose with a plug in one end such that the distance between the deck pipe and the plug is 6±4 in. (0.2±0.1 m).

9	Drip Pan	A pan placed under the fill area of the boat large enough to catch most or all of any blowback or overflow that may occur to prevent a safety hazard.



NOTE:
Insert the nozzle perpendicular to the fill fitting.

FIGURE 1. BLOW BACK TEST
TEST SCHEMATIC PROCEDURE

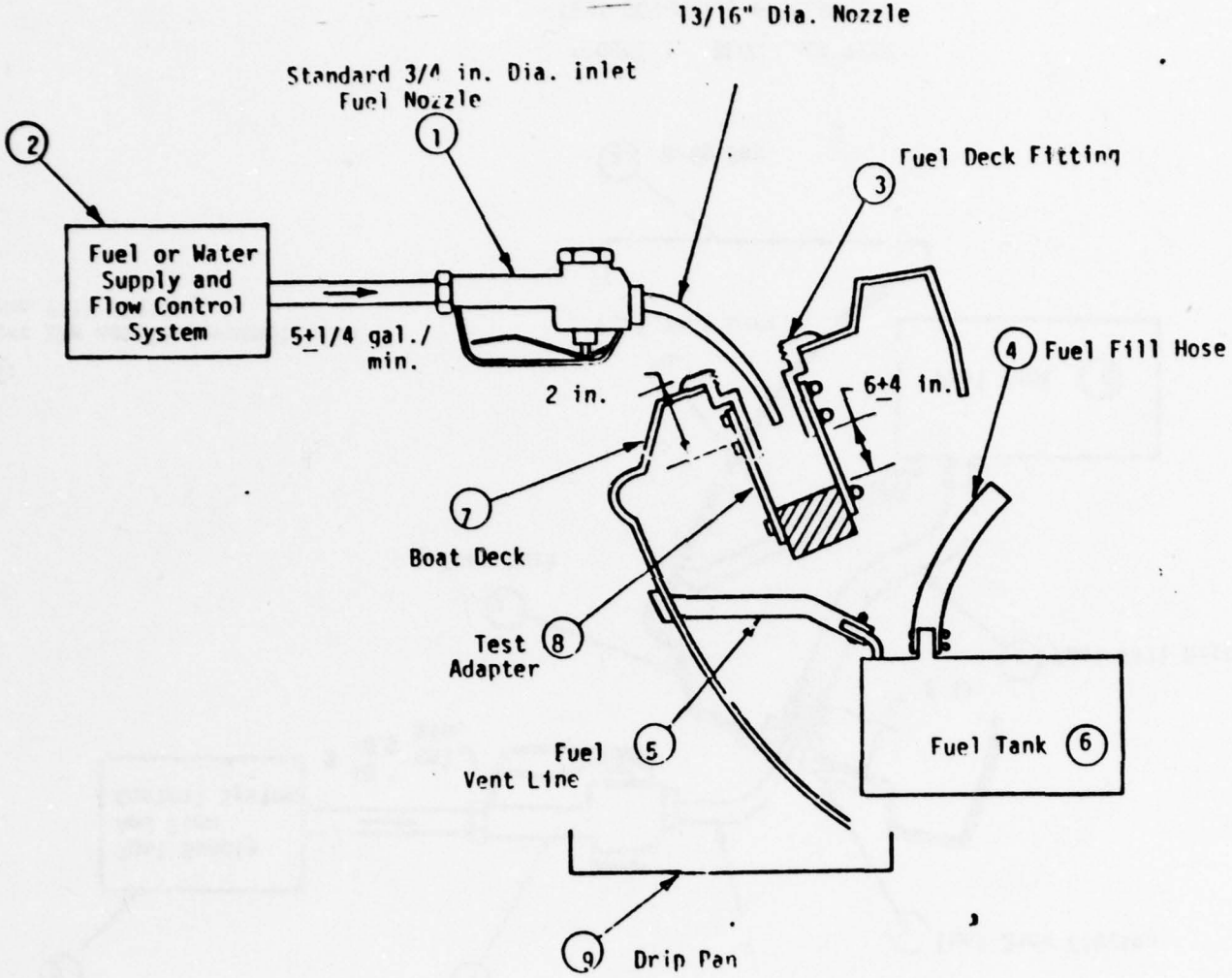


FIGURE 2. OVERFLOW TEST
TEST SCHEMATIC PROCEDURE

7.3 Test

7.3.1 This procedure shall be used to perform a blow back and overflow test of the fuel fill system after it has been installed in a boat. It shall verify that the combination of the boat configuration and the fill system meet the requirements as specified in this procedure.

7.3.2 Visually inspect the entire fuel fill and storage system for any discrepancies.

NOTE

This procedure has been written to test one fill system. If a boat has more than one tank, the connecting valves between them shall be closed such that each tank can be tested separately. A failure of any one fill port shall be cause for rejecting the entire fuel fill system of a particular boat.

7.3.3 Position the boat in its normal unloaded static floating position as specified in Paragraph 7.1.4. The determination of this position may be verified from previous testing documentation or by accomplishing Paragraph 7.1.4.

7.3.4 Verify that the fuel tank is empty of gasoline (less than 1 gal. (3.8 l). Verify that the vent hose is open and unobstructed.

7.3.5 Verify that the fuel tank is isolated from any other fuel tank, if another is installed, either by closing the valve or by capping or plugging the connecting line.

7.3.6 Blow Back Test -- (See Test Schematic Figure 1)

7.3.6.1 Determine the rated capacity of the fuel tank from the fuel tank label

7.3.6.2 Remove the fuel fillcap from the deck fitting and for every gallon of rated capacity add one quart (0.9 l) of gasoline to the fuel tank.

For Example: If the rated capacity of the fuel tank is 12 U.S. gal. (45.4 l), add 12 qt (or 3 gal. [11.4 l]) of gasoline to the fuel tank.

7.3.6.3 Using the rated capacity of the fuel tank from Paragraph 7.3.6.1 above, calculate the time required at the proper flow rate (9 gal./min. [34.1 l/min.]) to accomplish the test in the following equation:

Rated Capacity of Fuel Tank (gal.) x $\frac{10}{3}$ = No. of seconds of flow at 9 gal./min. (34.1 l).

Make this calculation (round to the nearest second) and record the time required (seconds) to complete the test

7.3.6.4 Verify that the fuel nozzle is set to flow at a constant flow rate of 8.5 to 9 gal./min. (32.2 to 34.1 l/min.).

7.3.6.5 Position a drip pan under the area of the boat where the gasoline is anticipated to drain in case of any blow back or overflow.

7.3.6.6 Verify that two fire extinguishers are available and properly positioned.

7.3.6.7 Verify that there is no smoking or any ignition source in the immediate area and that the test is ready to start.

7.3.6.8 Insert the fuel fill nozzle perpendicular to the deck fill fitting to a depth of 2 in. (5.1 cm) and gradually initiate (within 2 seconds) a constant gasoline flow of 8.5 to 9 gal./min. (32.2 to 34.1 l/min.). Time the flow from point of initiation until the time required by Paragraph 7.3.6.3 has elapsed, then immediately terminate the flow.

NOTE

It may be convenient to mark the fuel nozzle 2 in. (5.1 cm) from its end using a piece of tape or a permanent marker and insert the nozzle to this depth for the test.

During this flow period there shall be no discernible blow back of any fuel through the fill fitting.

Re-verify that the flow rate is 8.5 to 9 gal./min. (32.2 to 34.1 l/min.) as required and

Drain the fuel tank and repeat the test two

more times beginning each time with Paragraph 7.3.6.2. No blow back shall be allowed during either of these two runs. If any blow back is detected, the fill system shall be rejected.

7.3.7 Overflow Test

NOTE

This test is not required if it is obvious by visual observation that no overflow will enter the boat.

7.3.7.1 Disconnect the fill hose at the tank and plug or remove the fill hose and install the special test adapter as shown in the Test Schematic Figure 2. Either method is acceptable as long as the 6±4 in. (o.2±0.1 m) requirement is met. Measure this distance (bottom of deck fill fitting to top of test plug) in the final test configuration

7.3.7.2 Verify that the drip pan is still in place under the fill area of the boat.

7.3.7.3 Insert the fuel fill nozzle into the deck fill fitting to a depth of at least 2 in. (5.1 cm) and initiate a constant liquid flow of 5±0.25 gal./min. (18.9±0.9 l/min.) for 5 to 6 seconds. Record the time allowed for the system to overflow

NOTE

It may be convenient to mark the fuel nozzle 2 in. (5.1 cm) from its end using a piece of tape or a permanent marker and insert the nozzle to this depth for the test.

7.3.7.4 During the overflow test there shall be no observed flow of liquid gasoline into the interior of the boat. If any such liquid is observed, the fill system shall be rejected.

NOTE

Flow would normally occur over the top of the boat, however, any liquid flow into the interior of the boat shall be cause for rejection. For example, flow through the engine compartment ventilation louvers, if the deck fill fitting were located directly above them, would be a cause for rejection.

7.3.7.5 Secure the test setup as required and safe the area.

8.0 LAB EXAMINATION NO. 4 -- FUEL PUMP TEST

183.524 Fuel pumps

(a) Each diaphragm pump must not leak fuel from the pump if the primary diaphragm fails.

(b) Each electrically operated fuel pump must not operate except when the engine is operating or when the engine is started.

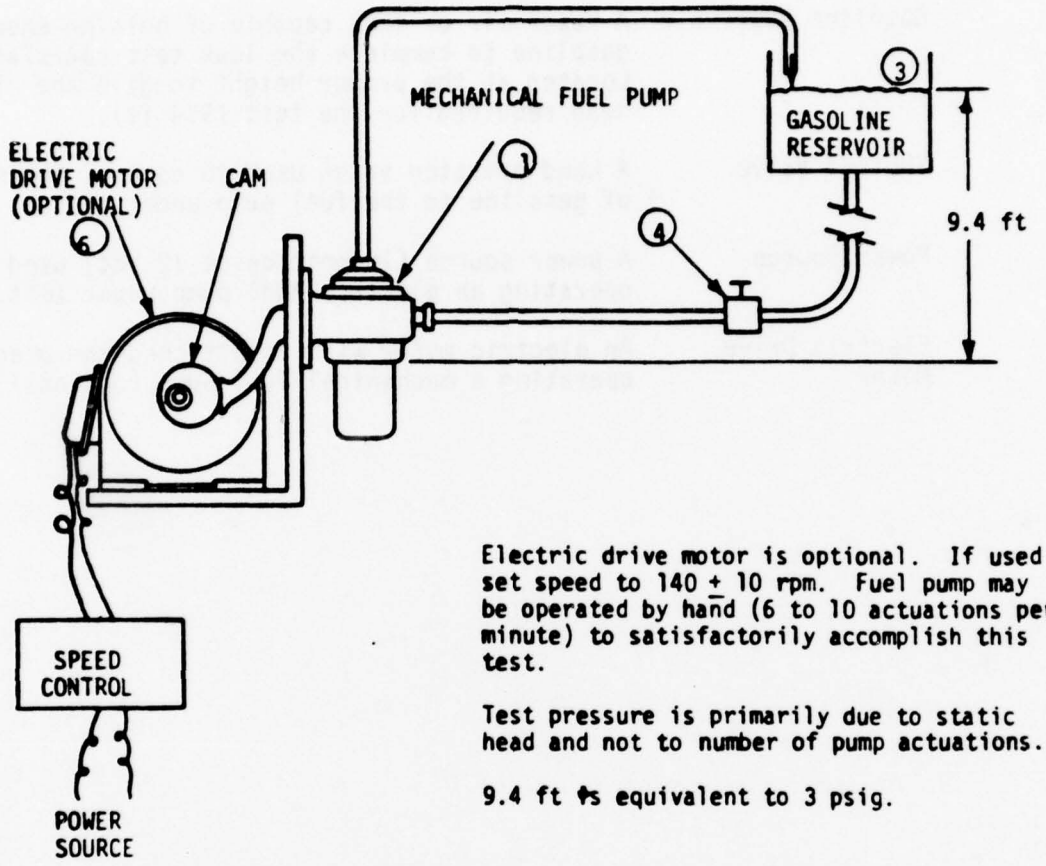
(c) If tested under § 183.590, each fuel pump, as installed in the boat, must not leak more than five ounces of fuel in 2½ minutes, inclusive of leaks from fuel line, fuel filter and strainer.

8.1 General Description - The fuel pump shall be mounted similar to a typical installation as shown in the Test Schematic and subjected to a 10 minute leak test using ordinary pump gasoline as the test media. The component shall not leak any gasoline during or after the 10 minute leak test. Electric fuel pumps which are received for test installed in a boat system shall be verified for proper electrical connection prior to removal for the leak test.

8.2 Test Equipment and Schematic

Component Find No.	Title	Description
1	Mechanical Fuel Pump	A standard ordinary fuel pump found on many marine engines. Pumping action is dependent upon rotation of the cam shaft. Pump is similar to many automobile engine fuel pumps except for marine applications pump must have non-leak capability when diaphragm ruptures.
2	Electric Fuel Pump	An electrically operated (usually 12 vdc) fuel pump usually capable of a higher output than mechanical pump and is not dependent on engine speed Must have non-leak capability, also, if diaphragm ruptures (reciprocating type only).

Component Find No.	Title	Description
3	Gasoline Reservoir	A reservoir or tank capable of holding enough gasoline to complete the leak test satisfactorily. Located at the proper height to give the static head required for the test (9.4 ft).
4	Shutoff Valve	A hand operated valve used to control the supply of gasoline to the fuel pump under test.
5	Power Source	A power source (in most cases 12 vdc) used for operating an electric fuel pump under test.
6	Electric Drive Motor	An electric motor with an attached cam used for operating a mechanical fuel pump (optional).

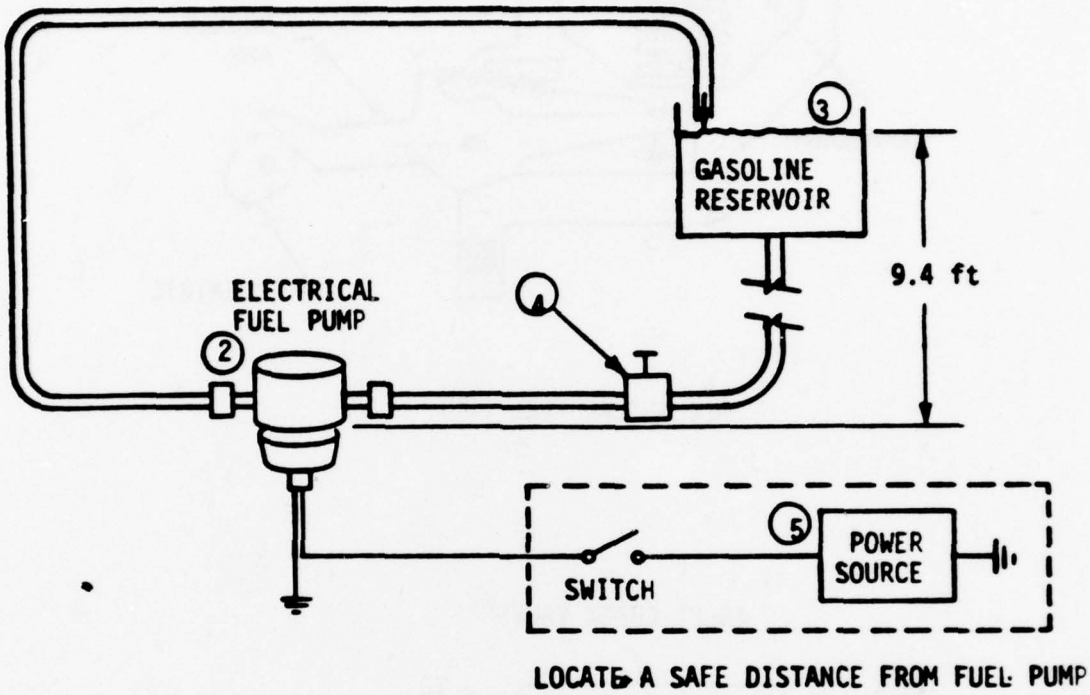


Electric drive motor is optional. If used set speed to 140 ± 10 rpm. Fuel pump may be operated by hand (6 to 10 actuations per minute) to satisfactorily accomplish this test.

Test pressure is primarily due to static head and not to number of pump actuations.

9.4 ft is equivalent to 3 psig.

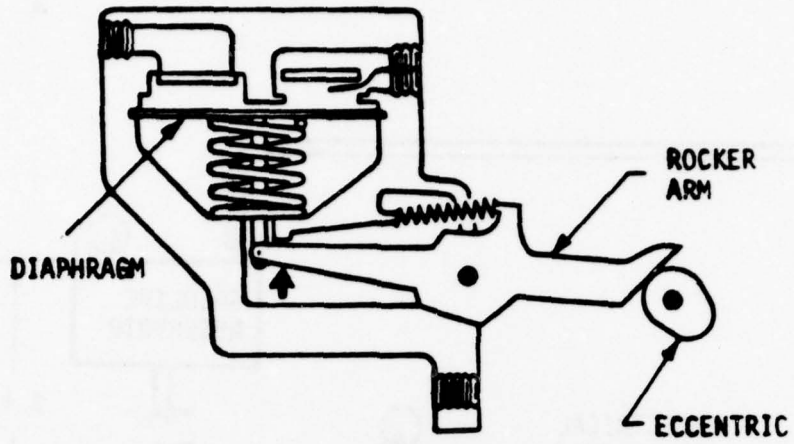
FIGURE 1. MECHANICAL FUEL PUMP



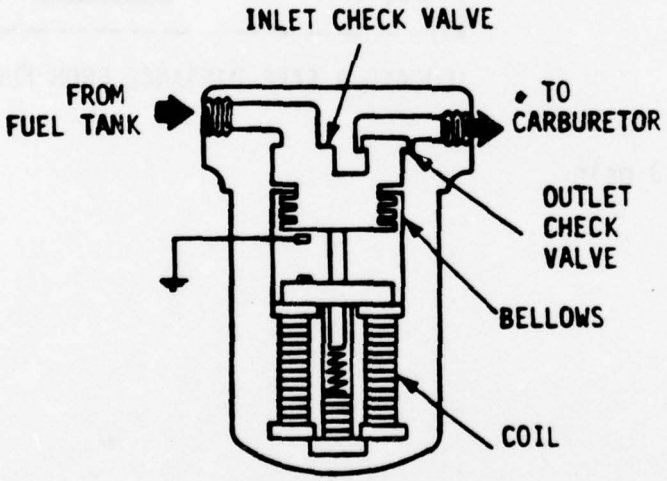
9.4 ft is equivalent to 3 psig.

TEST SCHEMATIC PROCEDURE

FIGURE 2. ELECTRIC FUEL PUMP



MECHANICAL FUEL PUMP



ELECTRIC RECIPROCATING FUEL PUMP

TEST SCHEMATIC PROCEDURE

FIGURE 3. CROSS SECTION OF FUEL PUMPS

8.3 Test -- Leak Test of Fuel Pump

8.3.1 This procedure shall be used to perform a leak and functional test of mechanical and electrical fuel pumps.

8.3.2 Visually inspect the component to be tested.

Verify the applicability of this procedure to the component being tested before proceeding.

8.3.3 Electric fuel pumps received for testing installed in a boat system shall be tested for proper electrical connection prior to removal from the boat for the leak test as follows:

1. The power supply to the pump must come through the ignition switch such that the pump will operate only when the switch is in the "ON" or "START" position.

2. If the pump has its own switch, verify that it is inoperable unless the ignition switch is in the "ON" or "START" position.

Verify that the above is true by physically operating the switches and observing or listening to the pump.

8.3.4 The leak test shall be performed on the component only in a special bench test setup due to the modification required on the pump to accomplish the test. Fuel pumps to be tested which are installed on an engine or in a boat system shall be removed for this test.

8.3.5 Disassemble the fuel pump to the level necessary to inspect and/or remove the primary diaphragm or bellows (see Figure 3 of the Test Schematic).

8.3.6 Using a sharp instrument, such as a knife or Razorblade , rupture only the primary diaphragm or bellows to an extent required to ensure leakage through the diaphragm or bellows. This should be at least a slit ¼ in. (0.6 cm) in length.

8.3.7 Reinstall the ruptured diaphragm or bellows into the fuel pump if it was removed and assemble the pump according to the manufacturer's specifications

8.3.8 Install the fuel pump on a bench test stand similar to a typical installation as shown in the Test Schematic, Figure 1 or Figure 2.

NOTE

In the case of a mechanical fuel pump, due to the elaborate system required to simulate actual operation of the pump, hand operation of the pump shall be acceptable for the purposes of this procedure. This will eliminate the need for the electric drive motor, cam, control, etc., and simplify the test to a great extent. Test pressure is supplied by the static head of the gasoline and the number of actuations of the fuel pump with the ruptured diaphragm will have little effect on the test.

8.3.9 With the shutoff valve closed, position the gasoline resevoir at the proper height. With the resevoir containing approximately 1 - 2 gal. (3.8 to 7.6 l) of gasoline the top of the liquid should be 2.9 to 3.1 ft above the primary diaphragm of the fuel pump.

8.3.10. If an electric fuel pump is being tested, verify that the power supply is a safe distance from the fuel pump and the gasoline resevoir (at least 7 to 8 feet [2.1 - 2.4 m]). In all cases verify that any other potential ignition source has been removed or is at least at a safe distance.

8.3.11 Verify that the system is ready for test and that all safety precautions are being observed. A CO_2 fire extinguisher or equivalent should be ready.

8.3.12 Open the shutoff valve and allow gasoline to fill the system including the pump. After 10 seconds perform a visual leak check of the fuel pump body, inlet and outlet connections, the rocker arm cavity and the sight glass (if installed).

NOTE

Some fuel pumps may have a sight glass or equivalent installed to observe leakage through the pump diaphragm.

Any leakage at the inlet and outlet connections does not invalidate the test but shall be corrected before proceeding with the test. If external leakage is discovered at the fuel pump body or at the sight glass and/or connections, the fuel pump shall be rejected. Slight wetting of the surface, without the formation of drops, is not considered leakage. If no leakage is observed, proceed with the test.

8.3.13 With the system full of gasoline, operate the fuel pump for 10 minutes and continuously check the pump for any leakage. There shall be no leakage of gasoline in excess of 5 oz. in 2 1/2 minutes, including leaks from the fuel line, filters and strainers at any time during the test.

NOTE

If a mechanical fuel pump is to be operated manually, the pump lever should be actuated 6 to 10 times per minute. If it is operated by an electric drive motor, adjust the motor speed to 140±10 rpm.

8.3.14 After 10 minutes of pump operation with no observed leakage, stop the test and carefully perform a final leak check as described in Paragraph 8.3.12. If leakage is found, the fuel pump shall be rejected. If no leakage is observed, the test component shall be deemed acceptable according to the requirements of this procedure.

9.0 LAB EXAMINATION NO. 5 -- CARBURETOR TEST

183.526 Carburetors

(b) Each carburetor must not leak more than five cubic centimeters of fuel in 30 seconds when—

(1) The float valve is open;

(2) The carburetor is at half throttle; and

(3) The engine is cranked without starting; or

(4) The fuel pump is delivering the maximum pressure specified by its manufacturer.

(c) Each updraft and horizontal draft carburetor must have a device that—

(1) Collects and holds fuel that flows out of the carburetor venturi section toward the air intake;

(2) Prevents collected fuel from being carried out of the carburetor assembly by the shock wave of a backfire or by reverse air flow; and

(3) Returns collected fuel to the engine induction system after the engine starts.

9.1 General Description -- The carburetor shall be mounted on a test assembly similar to that shown in the Test Schematic and subjected to a 30 second operational leak test using ordinary pump gasoline as the test media. The component shall not leak externally more than the specified limit during the test. The simulated manifold shall then be removed and the inlet fuel valve shall be tested for internal leakage. Finally, for carburetors of the horizontal and updraft type, a functional test of their drip collector devices shall be accomplished.

9.2 Test Equipment and Schematic

Component Find No.	Title	Description
1	Mechanical Fuel Pump	A fuel pump used on marine engines. Pumping action is dependent upon rotating motion of the camshaft when installed on an engine.
2	Electric Fuel Pump	An electrically operated (usually 12 vdc) fuel pump usually capable of a higher output than a mechanical pump and is not dependent on engine speed. Usually can be adjusted for different outputs.
3	Gasoline Resevoir	A reservoir or tank capable of holding enough gasoline to complete the test. Bottom of reservoir should be near level with the fuel pump used. With a return bleed line 2 gal. (7.6 l) should be sufficient for test.
4	Return Bleed Line	A return line from the 3-way valve used to recirculate fuel through the system and back to the reservoir. Ensures system is full of fuel prior to start of test.
5	3-Way Valve	A 3-way, 2-position valve used for directing fuel either back to the reservoir or through the carburetor.
6	Power Source	A power source (probably 12 vdc) used to operate the electric fuel pump (if used for this test).
7	Electric Drive Motor	An electric motor with an attached cam, control assembly, power source, tachometer, etc., used for operating a mechanical fuel pump if used in test.

Component Find No.	Title	Description
8	Carburetor	Standard marine engine carburetor required for test under this procedure.
9	Flame Arrestor Mounting Base	Air horn rim of carburetor.
10	Gasket	Standard carburetor to manifold/adapter gasket used to seal the interface from any gasoline or air leakage.
11	Mounting Plate	A plate or flange simulating the intake manifold on an engine to which the carburetor is mounted. Has same bolt pattern as the carburetor. Actually is the top part of the simulated manifold.
12	Simulated Manifold	A leaktight container which simulates the intake manifold of an engine and is capable of holding at least 1 gal (3.8 l of fuel. A vacuum equivalent to 3 inches of water may be provided to simulate actual usage.
13	Petcock	A valve in the bottom of the simulated manifold used for draining the fuel after each test and before starting the next test. Also, for verifying amount fuel flow during each test.
14	Flame Arrestor	A specially designed air filter to prevent external flame in case of an engin backfire.
15	Funnel Catch Basin	A funnel with a diameter at least 2 in. (5.1 cm) larger than the projection of the carburetor in all directions used for catching all of the carburetor external leakage.
16	Measuring Container	A graduated cylinder or beaker used fo catching and measuring the carburetor external leakage. Full capacity 10 ml with subdivisions 0.2 ml.

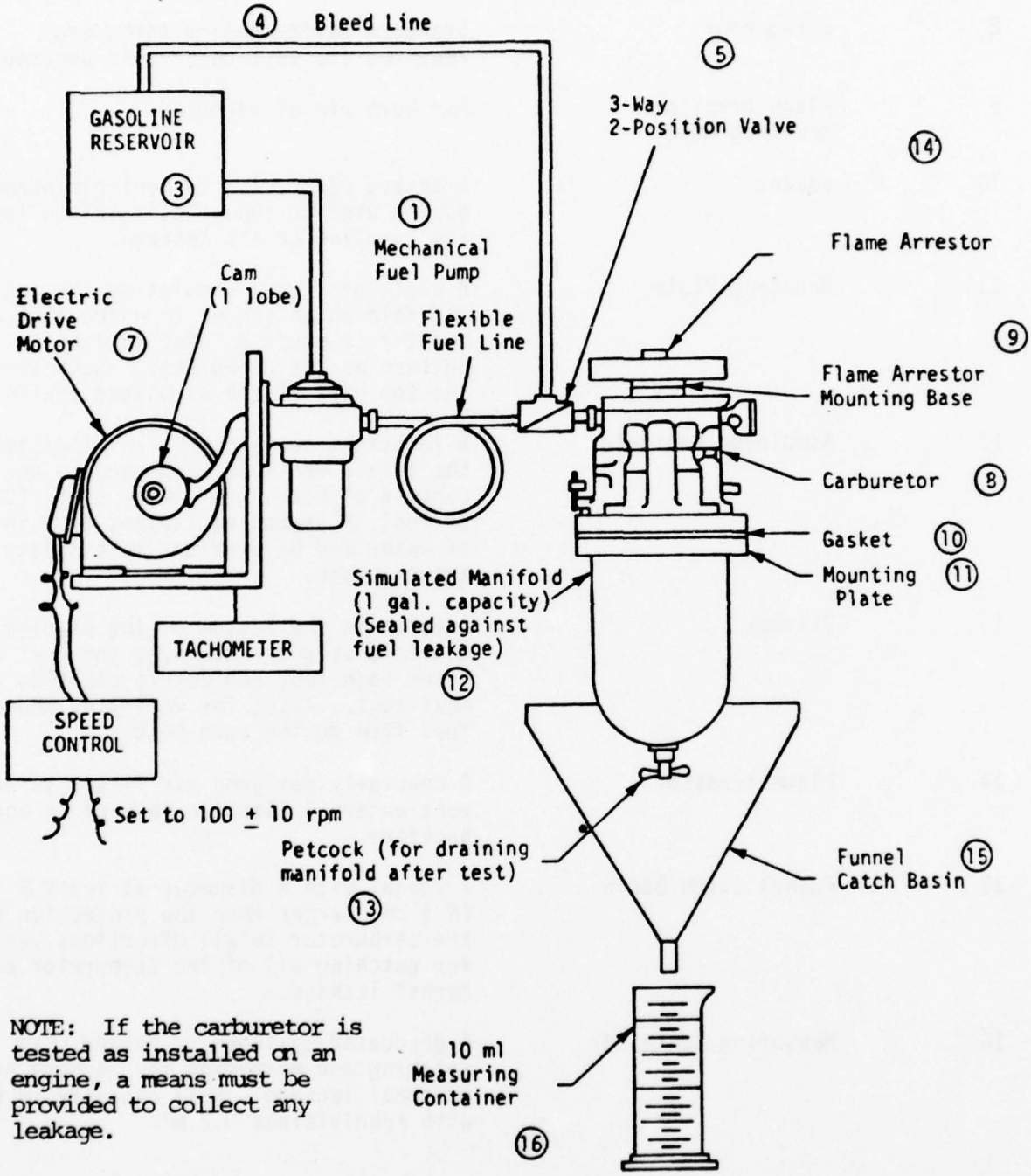
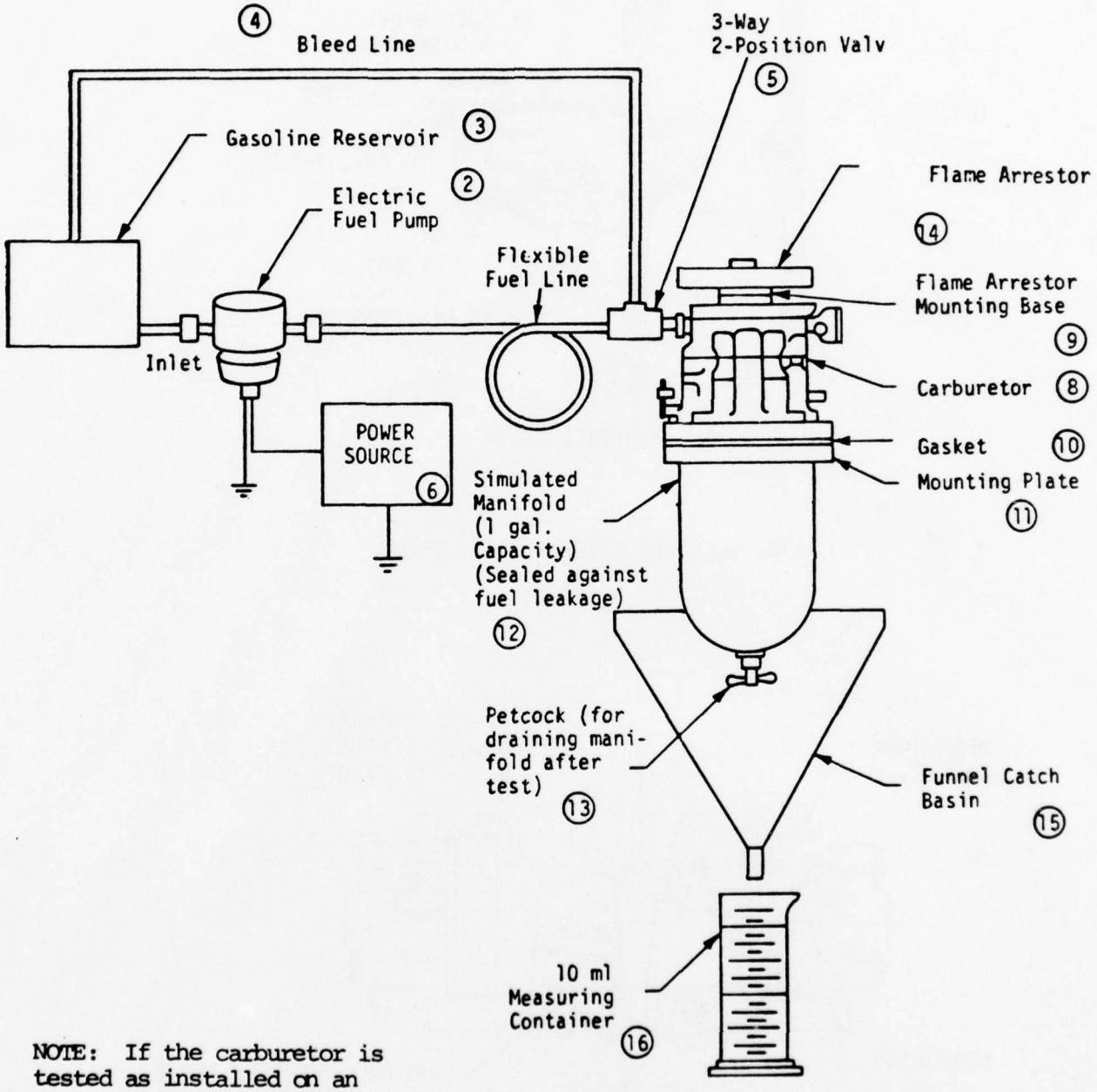


FIGURE 1. TEST SETUP USING A MECHANICAL FUEL PUMP



NOTE: If the carburetor is tested as installed on an engine, a means must be provided to collect any leakage.

FIGURE 2. TEST SETUP USING AN ELECTRIC FUEL PUMP

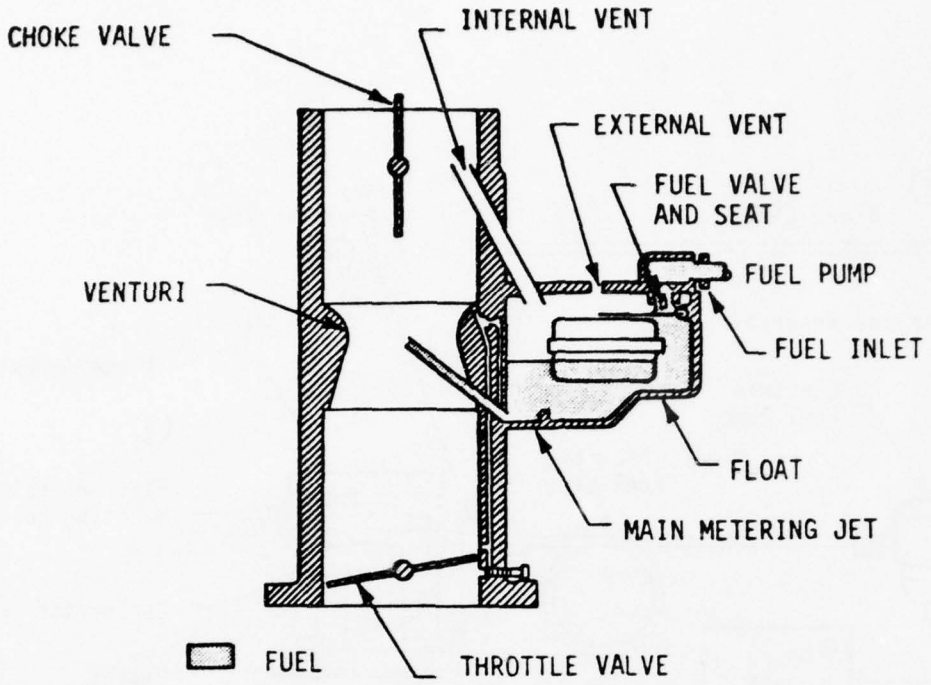


FIGURE 3. CARBURETOR FLOAT CIRCUIT

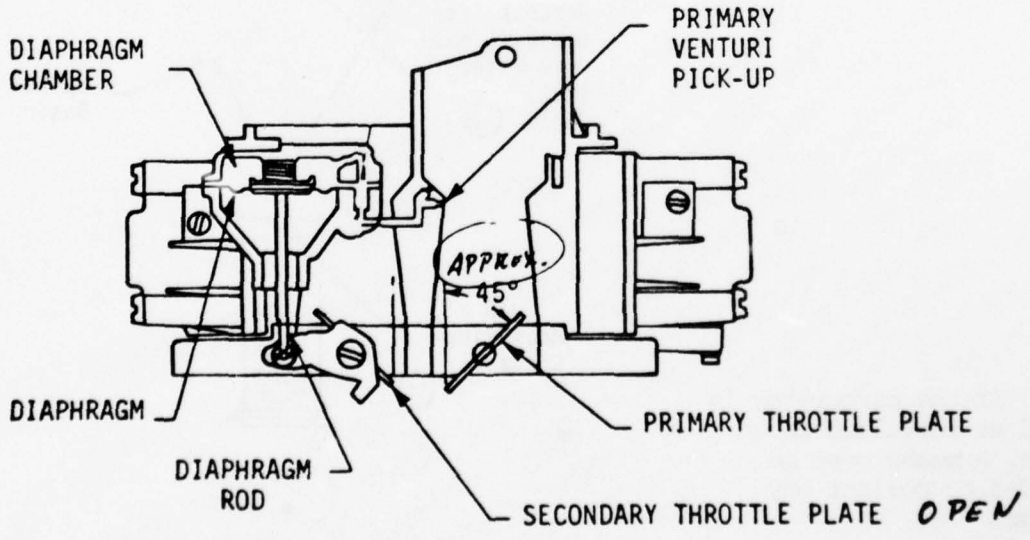


FIGURE 4. THROTTLE PLATE POSITION

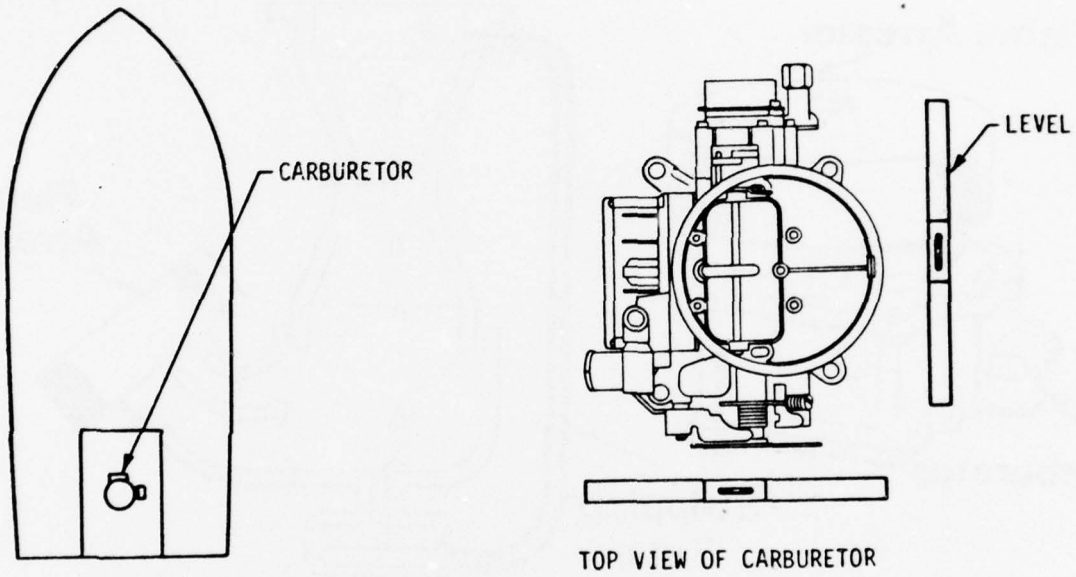


FIGURE 5. LEVELING OF CARBURETOR FOR TESTING

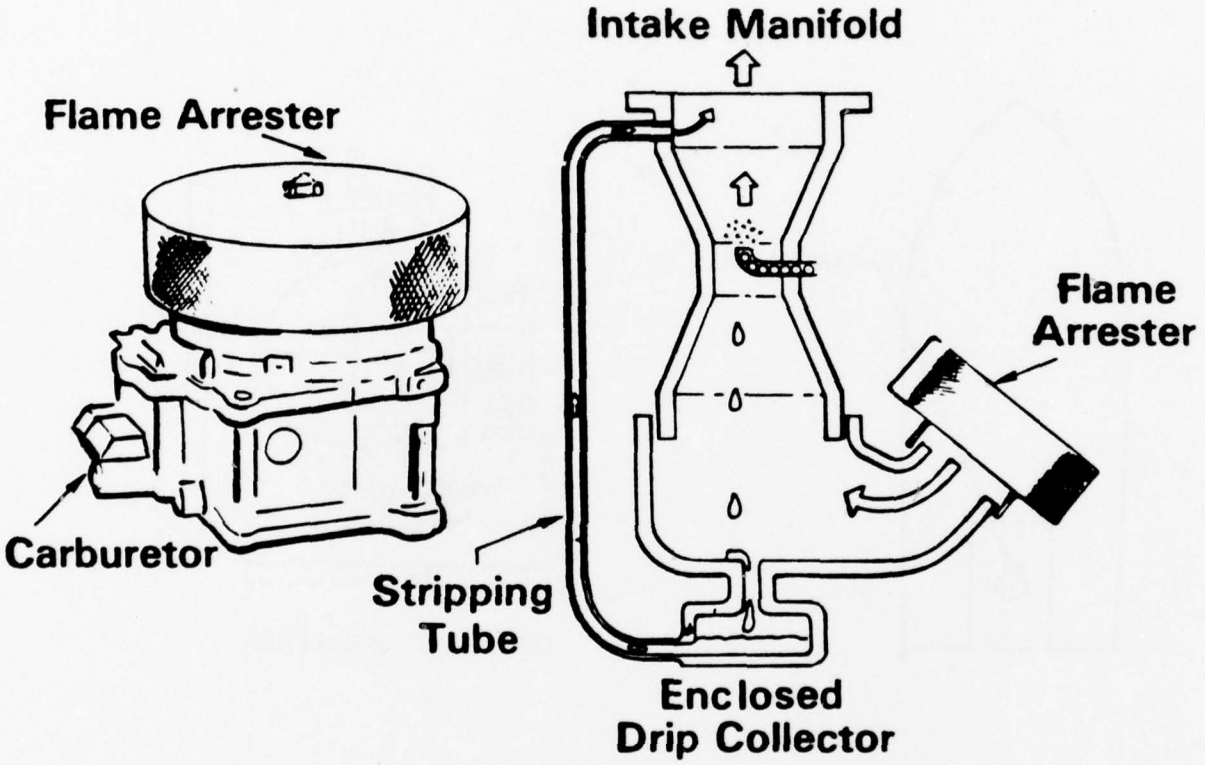


FIGURE 6. TYPICAL ACCEPTABLE SYSTEM

9.3 Test -- Leak Test of Carburetorss

9.3.1 This procedure shall be used to perform an operational leak test of carburetors (any type) and a functional test of horizontal and updraft type carburetors.

9.3.2 Visually inspect the component to be tested. Review the results of the Receiving Inspection (Data Form No. 1) and verify that the component is acceptable and ready for testing.

9.3.3 Verify the applicability of this procedure to the component being tested before proceeding.

Part 1 - External Leakage

9.3.4 This test shall be performed on the component only when installed on an engine similar to a typical installation and capable of measuring the required leakage points. If an engine has more than one carburetor, each carburetor shall be subjected to this procedure. The engine shall not be located in any direct sunlight or near any heat or air source.

9.3.5 Remove the flame arrestor and disassemble the carburetor to the level necessary to adjust and/or remove the float assembly in the fuel bowl.

9.3.6 Next, secure the float in a down position (fuel inlet valve full open). See Figure 3.

NOTE

If a particular carburetor being tested has more than one float and/or fuel bowls, all of the floats should be modified as described above.

9.3.7 Connect a fuel line with a 3-way valve from the carburetor inlet fitting to the outlet of the fuel pump being used for the test. The fuel line shall be the standard size as required by the carburetor in normal use

The valve shall be located within 1 foot of the carburetor inlet. Connect a bleed line from the valve back to the fuel reservoir. Install the flamer arrestor on the carburetor.

NOTE

The fuel bowl of the carburetor should be full or nearly full of fuel at the start of the leak test.

For this first test either fill the bowl through the bowl vent pipe or operate the fuel pump for a few seconds until the bowl is verified full. Remove any spilled fuel from the carburetor and test setup by wiping or blowing dry.

9.3.8 If an electric fuel pump is used as the gasoline pressure source for the carburetor, it shall be a model pump compatible with the engine and carburetor requirements. Position the pump and power source at least 6 feet from the carburetor under test. The power source shall be as specified by the pump manufacturer (in most cases 12vdc). If the pump output is adjustable, it shall be set to the maximum output (psi) specified by the engine manufacturer.

9.3.9 If a mechanical fuel pump is used as the gasoline pressure source for the carburetor, it shall be a model pump compatible with the engine and carburetor requirements. Position the pump and power source at least 6 feet from the carburetor under test. When the pump is mounted on an actual engine, the ignition system shall be disconnected so the engine will not fire. A special fuel source shall be utilized to ensure the proper flow of fuel to the carburetor. The engine shall be cranked in a normal manner at a speed consistent with a fully charged battery. Recharge battery as necessary for each test. When the pump is driven by an electric motor cam assembly (Figure 1), the speed of the motor shall be regulated to 140±10 rpm simulating an average cranking speed of a typical engine.

NOTE

The flow through the carburetor using either an electric or mechanical fuel pump will be very nearly the same volume in all cases. Actual flow will be mostly dependent on the internal design and sizing of the carburetor jets and orifices and not on the speed of the fuel pump.

9.3.10 Verify that the petcock in the bottom of the manifold is closed.

9.3.11 Verify that the 3-way valve is in the bleed position (recirculate back to fuel reservoir).

9.3.12 Verify that the entire system is in the proper configuration and ready for test.

9.3.13 Verify that all safety precautions are being observed. A CO_2 fire extinguisher or equivalent should be ready.

9.3.14 Actuate the fuel pump (either by cranking the engine or applying voltage). Observe the outlet of the bleed line. As soon as fuel flow is observed, recirculating back to the fuel reservoir, actuate the 3-way valve to the carburetor position and at the same instant start timing the flow of gasoline to the carburetor. Gasoline should flow to the carburetor for a period of 30 to 31 seconds. At the end of 30 seconds actuate the 3-way valve to the bleed position. Terminate operation of the fuel pump.

NOTE

A small amount of gasoline may continue to flow through the carburetor (and will continue to leak if the carburetor leaks) for a few seconds after the 3-way valve is actuated to the bleed position. This is to be expected and any such leakage shall be included in the total leakage. Leakage as used in this procedure shall be defined as "external only" leakage from the carburetor body (places such as the throttle shaft, idle fuel mixture needle valves, accelerator pump operating shaft, choke shaft, power valve housing and diaphragm assembly, sight plugs, external adjusting screws, and any other external sources). The only exception to this shall be at the inlet fuel B-nut. This fitting shall be considered as a part of the fuel supply system and not as a part of the carburetor, but must be leak tight so as not to contribute to any carburetor external leakage. If leakage is noted at this B-nut, the leakage shall be corrected and the test rerun. All internal flow through the carburetor throat into the simulated manifold is not considered external leakage in Part 1 of this procedure.

9.3.15 If the carburetor body contains any exterior wells or crevices filled with visible quantities of fuel, remove that fuel with an eye dropper and add this to the quantity caught in the measuring container. Remove as much fuel as possible by this method.

9.3.16 Measure the amount of fuel contained in the measuring container. If the amount is 5 cc or greater, the carburetor shall be rejected.

NOTE

Due to the surface area of the carburetor, manifold and funnel, if 5 cc of fuel is caught in the measuring container, more than 5 cc of fuel had to leak from the carburetor and the carburetor should be rejected.

9.3.16 If the amount is 4 cc or less, the carburetor shall be deemed acceptable according to the requirements of Part 1 of this procedure..

Do not accomplish Paragraph 9.3.17.

9.3.17 If the amount is more than 4 cc but less than 5 cc, use an absorbent pad or equivalent (ball of cotton, blotter, sponge, etc.) and absorb as much of any existing fuel as possible found on the carburetor, simulated manifold and funnel. Using a laboratory scale, weigh the absorbent pad dry before absorbing the fuel and then weigh again after absorbing the fuel.

Subtract the dry weight of the absorbent pad from its wet weight and divide this by 0.75 (1 cc of gasoline weighs 0.75 grams) to give cc's of fuel. Add this amount to the previous measured leakage for total fuel leakage of the carburetor. If this amount is greater than 5 cc, the carburetor shall be rejected.

If the amount is 5 cc or less, the carburetor shall be deemed acceptable according to the requirements of this procedure (Part 1).

Part 2 - Inlet Fuel Valve Leakage

9.4 Remove the funnel and drain the test fuel from the simulated manifold through the petcock. Remove the simulated manifold from the carburetor. Empty the measuring container of any test fuel and reposition the funnel and container under the carburetor.

9.4.1 Remove the flame arrestor and adjust the throttle plate(s) to be in the normal fully closed position.

9.4.2 Disassemble the carburetor to the level necessary to adjust the float assembly back to its original normal configuration. Adjust the float level to the manufacturer's specifications. Remove the carburetor from the test assembly if necessary to accomplish the above steps.

9.4.3 Re-assemble the carburetor to operational configuration. Replace any gaskets or seals which may have been damaged during disassembly. Re-install the carburetor on the test assembly if it was removed in Paragraph 9.4 and reconnect the fuel inlet line.

9.4.4 Position and secure the carburetor/test assembly in a level position as measured at the air horn rim per Figure 5.

NOTE

Do not install the flame arrestor on the carburetor for this test.

9.4.5 Secure the choke plate in the fully open (choke off) position.

9.4.6 Verify that the 3-way valve is in the bleed position (recirculate to fuel reservoir).

9.4.7 Verify that the entire system is in the proper configuration and ready for test.

9.4.8 Verify that all safety precautions are being observed. A CO_2 fire extinguisher or equivalent should be ready.

9.4.9 Actuate the fuel pump (either by cranking the engine or applying voltage).

NOTE

The requirements for pump speed and/or output (psi) are the same as per Paragraphs 9.3.8 and 9.3.9.

9.4.10 Observe the outlet of the bleed line. As soon as fuel flow is observed recirculating to the fuel reservoir, actuate the 3-way valve to the carburetor position and at the same instant start timing the flow of gasoline to the carburetor. Gasoline should flow (or be available) to the carburetor for a period of 29 to 30 seconds. During this period there should be no more than 5 cc observed gasoline flow coming from the fuel bowl vent port or any other port on the carburetor. This includes external and internal flow.

NOTE

All internal flow through the carburetor throat into the funnel as well as all external body leakage shall be included in the total leakage for Part 2 of this procedure.

At the end of 30 seconds actuate the 3-way valve to the bleed position. Terminate operation of the fuel pump.

Measure the amount of fuel contained in the measuring container. If the amount is greater than 5 cc, the carburetor shall be rejected.

If the amount is 5 cc or less, the carburetor shall be deemed acceptable according to the requirements of Part 2 of this procedure.

Continue on to Part 3 of this procedure if it is applicable.

9.4.11 Secure the test system as required and safe the area.

Part 3 - Horizontal and Updraft Carburetors

9.5 This test is applicable only to horizontal and updraft type carburetors and shall be used to functionally test the drip collector devices utilized on these carburetors to collect any excess fuel.

NOTE

If it is readily apparent by visual inspection that the collector system utilized on the carburetor is capable of preventing any outflow (blow out or dripping) of collected fuel from the carburetor assembly in the event of a shock wave due to a backfire or reverse air flow and is designed so as to return the collected fuel to the engine induction system after the engine starts, the collector system shall be deemed acceptable according to the requirements of Part 3 of this procedure.

9.5.1 The test shall be performed on the carburetor when it is installed on an operable engine. Operation or modified operation of the engine may be required to perform parts of the test.

9.5.2 Visually inspect the carburetor for a suitable collector device. Any horizontal or updraft carburetor which has no provision for collecting and holding fuel drippage shall be rejected.

9.5.3 Verify the engine (carburetor) is in an attitude recommended by the manufacturer or as installed in the boat, with all necessary hardware and

items required to operate that particular engine such as a gasoline supply system, battery, etc., available.

9.5.4 Position the choke (if manual) in the fully closed (choke on) position. If the choke is automatic, verify that it is in the proper position for starting a cold engine.

9.5.5 Position the throttle to the normal starting position. For most engines this should be in a half-throttle or part throttle position.

9.5.6 Install the flame arrestor on the carburetor.

NOTE

The flame arrestor shall not be used as a drip chamber unless a part of it has been specifically designed to function as such.

9.5.7 Remove the ignition wires from all spark plugs to prevent the engine from firing.

9.5.8 If possible place a paper towel or a clean rag under the collector area of the carburetor in order to catch any external dripping of fuel for easier identification of an unacceptable collector. If this cannot be done, visual observation of external drippage during the test shall be sufficient.

9.5.9 Verify that all safety precautions are being observed and that the area is well ventilated. If possible, the exhaust should be vented outdoors. A CO_2 fire extinguisher or equivalent should be ready.

9.5.10 If the engine has an electric starter, crank the engine for two minutes of cranking time in 10 second intervals; that is, crank the engine for 10 seconds, pause for 10 seconds, then crank again for 10 seconds. If the battery/starter system does not have this capability, crank the engine in the same 10 second intervals to the maximum extent possible, for the particular system. If the engine does not have an electric starter, manually crank the engine for 12 cycles in a normal manner (approximately 1 minute total).

9.5.11 During the above cranking test and immediately afterwards, visually observe the carburetor/collector system for any external leakage from the air inlet or drippage of liquid fuel from joints in the air inlet components.

There shall be none allowed during or after the test.

9.5.12 Connect all the ignition wires to the proper spark plugs.

NOTE

The battery may require replacement with a fully charged one prior to conducting the following tests:

9.5.13 After completing Paragraphs 9.5.10 and 9.5.11 and with the collector system containing the amount of fuel normal for 2 minutes of cranking, the engine shall be intentionally caused to backfire through the carburetor by any suitable means. For example, utilizing the valve-timing diagrams for the particular engine, one of the ignition wires may be connected to a different cylinder causing that cylinder to backfire through the intake valve. Ignition timing, valve phasing, or valve adjustment may be modified as necessary for easier accomplishment of the backfire.

NOTE

The actual backfire should be verified audibly, by use of a pressure transducer or gauge or by any other suitable means.

During the engine backfire no liquid fuel shall exit from the carburetor and/or flame arrestor.

NOTE

The following reverse air flow test is probably much less severe than the above backfire test for most engines (and it was probably done during completion of Paragraph 9.5.11 anyway). If it can be shown to be less severe than the backfire test, it does not need to be accomplished.

9.5.14 Based on previously accepted test data, verify the reverse air flow test is less severe than the backfire test.

9.5.15 Remove all the spark plug ignition wires.

9.5.16 Verify accomplishment of reverse air flow through the carburetor(s) when Paragraph 9.5.12 was completed satisfactorily; or with the collector system containing the normal amount of fuel for 2 minutes of cranking, crank the engine in a manner similar to that in paragraph 9.5.11 until a reverse air flow is verified; or with the collector system containing the normal

amount of fuel for two minutes of cranking, inject a volume of GN_2 at a pressure consistent with the compression ratio of the engine into the spark plug hole of a cylinder in which the piston is approaching the firing position of its stroke (approximately 2 - 10° BTDC) causing a counter rotation of the engine and a reverse air flow through the carburetor; or with the collector system containing the normal amount of fuel for two minutes of cranking, inject a volume of GN_2 into the spark plug hole of a cylinder in which the piston is near BDC with the intake valve open of sufficient quantity and pressure to cause a normal average reverse air flow through the carburetor; or any other suitable method to give the same results. In any case there shall be no liquid fuel observed exiting from the carburetor and/or flame arrestor.

9.5.17 Start the engine and verify by visual inspection that the collector system returns the collected fuel to the engine induction system after the engine starts. If the carburetor/collector system passes this test, it shall be deemed acceptable according to the requirements of this procedure.

9.5.18 Secure the test system as required and safe the area.

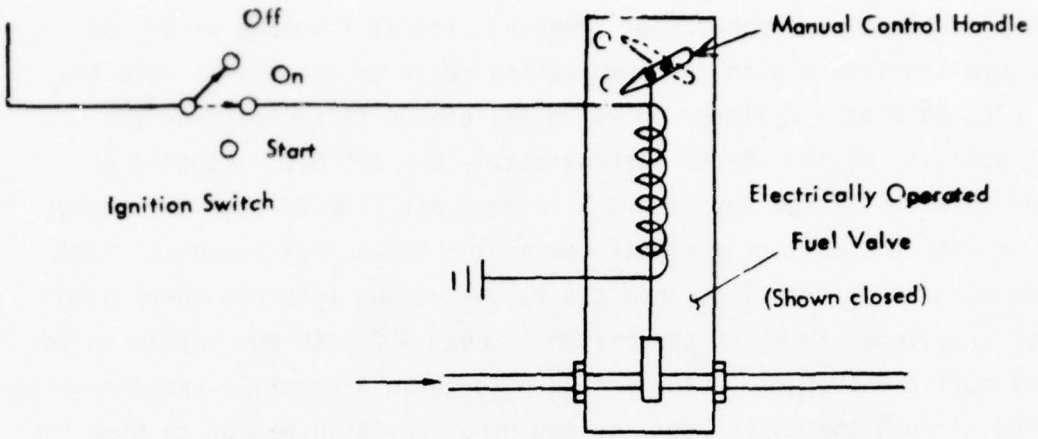
10.0 LAB EXAMINATION NO. 6 -- FUEL STOP VALVE TEST

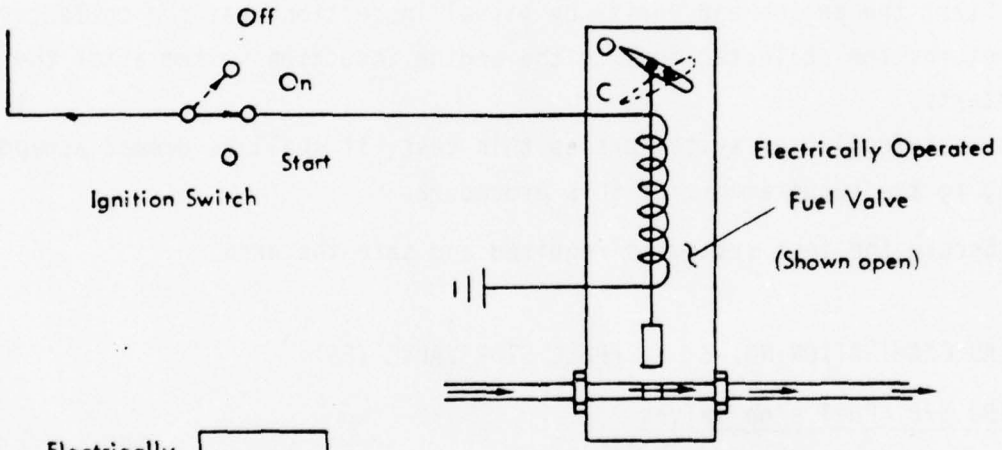
183.528 Fuel stop valves

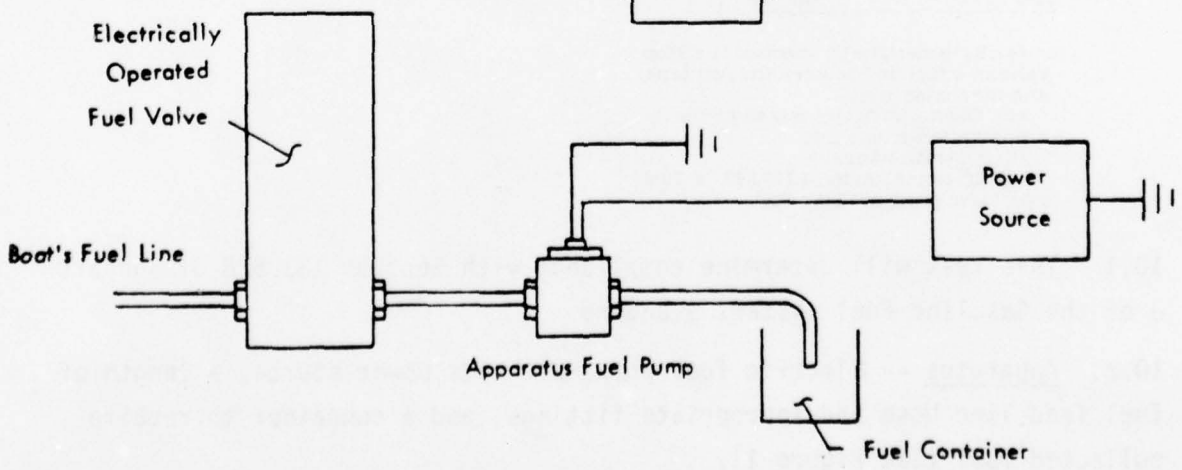
(a) Each electrically operated fuel stop valve in a fuel line between the fuel tank and the engine must—
(1) Open electrically only when the ignition switch is on; and
(2) Operate manually.
(b) If tested under § 183.590, a fuel stop valve must not leak fuel.

10.1 This test will determine compliance with Section 183.528 of Subpart J of the Gasoline Fuel Systems Standard.

10.2 Apparatus -- Electric fuel pump with its power source, a length of fuel feed line hose and appropriate fittings, and a container to receive collected fuel (See Figure 1).


Off
On
Start
Ignition Switch
Manual Control Handle
Electrically Operated
Fuel Valve
(Shown closed)


Off
On
Start
Ignition Switch
Electrically Operated
Fuel Valve
(Shown open)


Electrically
Operated
Fuel Valve
Boat's Fuel Line
Power
Source
Apparatus Fuel Pump
Fuel Container

10.3 Test Specimens -- Electrically operated fuel valves as installed in the boat.

10.4 Test Conditions -- Operable fuel and electrical system as installed in the boat.

10.5 Procedure --

10.5.1 Electrical operation.

10.5.1.1 With the engine's ignition switch in the "OFF" position, disconnect the fuel line on the output side of the electrically operated fuel valve.

10.5.1.2 Connect the apparatus hose and fuel pump to the output side of the valve to collect any pumped fuel.

10.5.1.3 With the apparatus fuel pump energized, turn the engine's ignition switch on, and determine whether the electrically operated fuel valve is energized to the open position by the presence or absence of fuel flow from the fuel tank into the apparatus container.

10.5.1.4 Turn the engine's ignition switch off and determine whether the valve is energized as per Paragraph 10.5.1.3 above.

10.5.2 Manual operation.

10.5.2.1 Determine whether the electrically operated fuel valve has a provision for manual operation.

10.5.2.2 If so, and with the engine's ignition switch in the "OFF" position, energize the apparatus fuel pump, open the electrically operated fuel valve using the manual operation provision and determine whether fuel flows into the apparatus container.

10.5.2.3 Close the electrically operated fuel valve again using the manual operation provision and determine whether the fuel flow stops.

11.0 LAB EXAMINATION NO. 7 -- TEST OF SEALS AND GASKETS

183.536 Seals and gaskets in fuel filters and strainers

(a) Each gasket and seal used in a fuel filter and strainer must form an unsplit ring.

(b) Each gasket and each sealed joint in a fuel filter and strainer must not leak when subjected for 24 hours to a gasoline that has at least a 50 percent aromatic content at the test pressure determined under § 183.582(a).

11.1 Apparatus - Two Containers, lines, shut-off valves, one gallon of gasoline, as shown in Figure 1.

11.2 Test Specimens - Remove the fuel filter(s) or strainer(s) as installed in the boat.

11.3 Test Procedure

11.3.1 Precondition the test specimen by connecting it to the apparatus shown in Figure 1.

11.3.2 The lower apparatus shut-off valve shall be closed. The upper apparatus shut-off valve shall be opened allowing gasoline from the reservoir to fill the specimen. This condition shall be maintained for 24 hours.

11.3.3 The top level of the gasoline in the reservoir shall be of the proper height to produce a 4.6' head or the maximum hydro-static head for the installation being tested, whichever is greater, for the 24 hours.

11.4 After the 24 hour period, open the lower valve to drain the fuel.

11.4.1 Disassemble and inspect the specimen.

11.5 Determine whether the gasket or seal is a complete ring and not split.

11.6 Carefully clean the specimen and its gasket(s) or seal(s).

11.7 Reassemble the specimen. Observe and report any difficulties encountered.

11.8 Reconnect the specimen to the test apparatus shown in Figure 1.

11.9 Re-subject the specimen to the head as determined in Paragraph 11.3.3 for a period of one hour.

11.9.1 Observe and report any leaking around the gasket or seal.

11.10 Adjust the apparatus shut-off valve to an open position to allow one gallon of gasoline to flow through the specimen in 10 to 12 minutes.

11.10.1 Observe and report any leaking around the gasket or seal during this period.

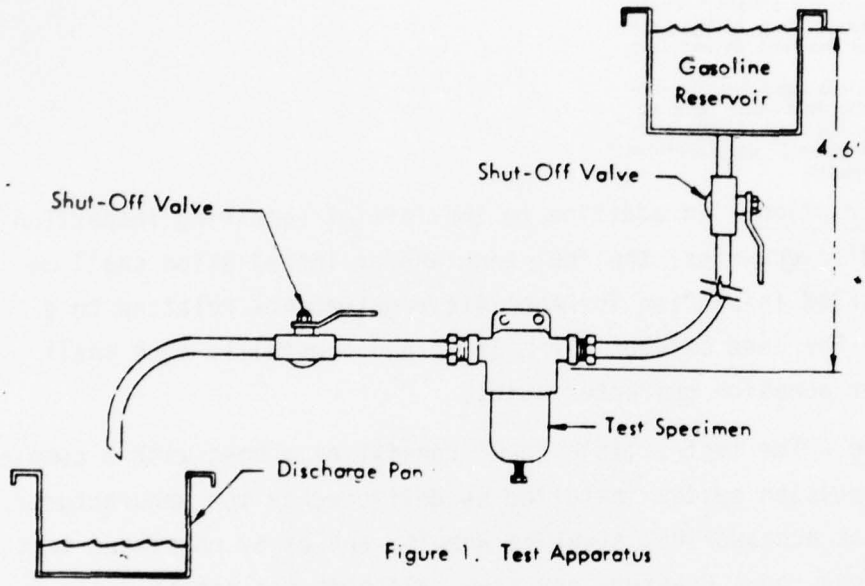


Figure 1. Test Apparatus

* or maximum hydro-static head to which the specimen is subjected on the boat, whichever is greater - The maximum hydro-static head is determined by measuring the vertical distance from the highest fuel carrying point in the fuel system when the fuel system is "topped off", to the gasket or seal in the item to be tested.

12.0 LAB EXAMINATION NO. 8 -- BOND TEST OF FOAM TO TANK

183.552 Plastic encased fuel tanks; installation

(a) Each fuel tank encased in cellular plastic foam or in fiber reinforced plastic must have the connections, fittings, and labels accessible for inspection and maintenance.

(b) If a metallic fuel tank is encased in cellular plastic or in fiber reinforced plastic, water must not collect between the plastic and the surface of the tank or be held against the tank by capillary action.

(c) If the plastic is bonded to the surface of a metallic fuel tank, the adhesive strength of the metal to the plastic bond must exceed the cohesive strength of the plastic.

12.1 General Description - In addition to the initial receiving inspection (for general type discrepancies) the fuel tank and/or installation shall be subjected to a detailed inspection for specific requirements relating to a tank installation. The bond between any plastic and a metallic tank shall be tested for proper adhesion characteristics.

12.1.1 Test Article - The test article shall consist of a boat with a complete fuel system and propulsion system installed as delivered by the manufacturer. Certain items such as accessories, steering wheels, and other unrelated test equipment are not required. However, any item, although not specifically in the fuel system, but which, if installed, would affect the fuel tank and/or system in some manner (access, for example), that item shall be required as part of the test article.

12.2 Test Equipment and Material

Component Find No.	Title	Description
1	Plastic Test Tool	A pair of hand operated pliers with special grips used for pulling plastic foam greater than 1 in. (2.5 cm) thick. If not available use a standard off-the-shelf pair of 12½ in. or 16 in. arc joint pliers.
2	Spatula	Standard off-the-shelf spatula used to verify the bonding uniformity of the plastic foam to the tank.
3	Chisel	Standard off-the-shelf 1 in. wood chisel used for testing the bond between the plastic foam and tank when the foam is less than 1 in. (2.5 cm) thick.

Component Find No.	Title	Description
4	Dye Solution	A bright colored solution (probably red) that is easily seen and recognized. Used for testing penetration of the bond and plastic. Dye colored water or ink, for example.
5	Gaseous Pressurant	Compressed air or GN_2 used to pressure cycle the fuel tank.
6	Putty Knife	Standard off-the-shelf 1 in. (2.5 cm) putty knife used for clearing areas of plastic from the tank.

12.3 Test

12.3.1 Determine the unloaded static floating position as is described in Paragraph 7.1.4.

12.3.2 This procedure shall be used to perform an acceptance test of a fuel tank installation. It includes a visual inspection for certain requirements in addition to a pull test on the cellular plastic foam or fiber reinforced plastic when bonded to metallic tanks. If a failure or discrepancy is noted at any point beginning with Paragraph 12.4, the fuel tank installation shall be rejected and the test terminated at that point.

12.3.3 Visually inspect the fuel tank installation to be tested. Review the results of the Receiving Inspection and verify that the test article is acceptable and ready for testing.

NOTE

The above visual inspection is strictly general in nature (for discrepancies such as damage, missing items, etc.) and in no way attempts to identify any specific requirements.

12.4. Visual Tests

12.4.1 If the fuel tank is encased in foam or cellular plastic, verify that it has a label that is readily visible without removing the tank or other equipment, that it is permanently attached to the tank and contains letters and numbers which are at least one-sixteenth (1/16) of an inch in height. The letters and numbers shall be of contrasting color to the basic color of the label or embossed

on the label, and shall be of such construction as to resist removal or alteration of the information without leaving obvious signs of such action.

NOTE

The above inspection shall be qualitative only in nature with the exception of the 1/16 of an inch requirement.

Verify that the label contains at least the following information

1. Fuel tank manufacturer's name (or logo) and address
2. Month (or lot number) and year of manufacture
3. Capacity in U. S. gallons
4. Material of construction
5. The pressure the tank is designed to withstand without leaking
6. Model number, if applicable
7. The statement, "This tank has been tested under 33 CFR 183.580."
8. If the tank is tested under the 33 CFR 183.584 at less than 25 g vertical acceleration, the statement, "Must be installed aft of the boat's half length."

NOTE

The above items shall not be tested or verified for accuracy. Verify only that they are listed on the fuel tank label, if applicable (items 6 and 8 will not be applicable to all tanks).

If the fuel tank fails to meet all of the above requirements, the fuel tank installation shall be rejected.

12.4.2 In addition to the accessibility of the label requirement for inspection of encased fuel tanks, as tested in Paragraph 12.4.1, verify that all fuel tank connections and fittings are accessible for inspection and maintenance. If the requirement is not met, the installation shall be rejected.

12.4.3 Using the information listed on the fuel tank label, verify the following requirements

1. A fuel tank shall not be constructed from terneplate.
2. A fuel tank shall not be constructed from black iron or carbon steel unless it has an inorganic sacrificial galvanic coating on the inside and outside of the tank.
3. A fuel tank encased in cellular plastic or in fiber reinforced plastic shall not be constructed from a ferrous alloy.

NOTE

For the above requirements if the information on the fuel tank label is incomplete or vague to the extent that there is any doubt as to the exact material or construction used in the tank, the fuel tank installation shall be rejected.

4. A fuel tank labeled for installation aft of a boat's half length shall be installed with its center of gravity aft of the boat's half length.

NOTE

If the tank is not labeled for installation in the aft half length of the boat, it may be installed anywhere in the boat as long as it meets all other requirements, and as a result, Paragraph 4 above is not applicable.

NOTE

If the tank is labeled for aft installation only and the requirement has obviously been met, disregard the following calculations.

For the purposes of this procedure the following method shall be used in determining acceptance of the tank according to the location requirement:

a) The fuel tank shall be considered empty, level and symmetrical. Thus, the center of gravity shall be at one-half (½) the length of the tank. Locate and mark this point as accurately as possible (within ±1 inch) in relation to the longitudinal axis of the boat.

b) Determine the length of the boat in the following manner (see Figure):

b-1) Locate the point on the centerline of the boat where the sheer intersects the forward face of the stem. Mark this point: Point "S".

b-2) Locate the point on the centerline of the boat where the sheer intersects the after face of the transom. Mark this point: Point "T".

b-3) Place the boat on a boat trailer or chocks on a flat floor and trim the boat until Points "S" and "T" are equal distances from the floor. For the purposes of this test the floor shall be flat to within one-quarter (¼) of an inch.

b-4) Drop a plumb bob from Point "S" to the floor and from Point "T" to the floor and using a tape, measure the length (L) between the two projected points rounding up to the nearest inch.

c) Assume a vertical plane "X" through the longitudinal center "M" of the fuel tank and perpendicular to the longitudinal axis of the boat. Assume a vertical plane "Y" through Point "T" and perpendicular to the longitudinal axis of the boat. Measure the perpendicular distance between these two planes rounding down to the nearest inch.

d) The distance (D) as determined in Paragraph (c) shall be equal to or less than one-half (½) the length (L) as determined in Paragraph (b).

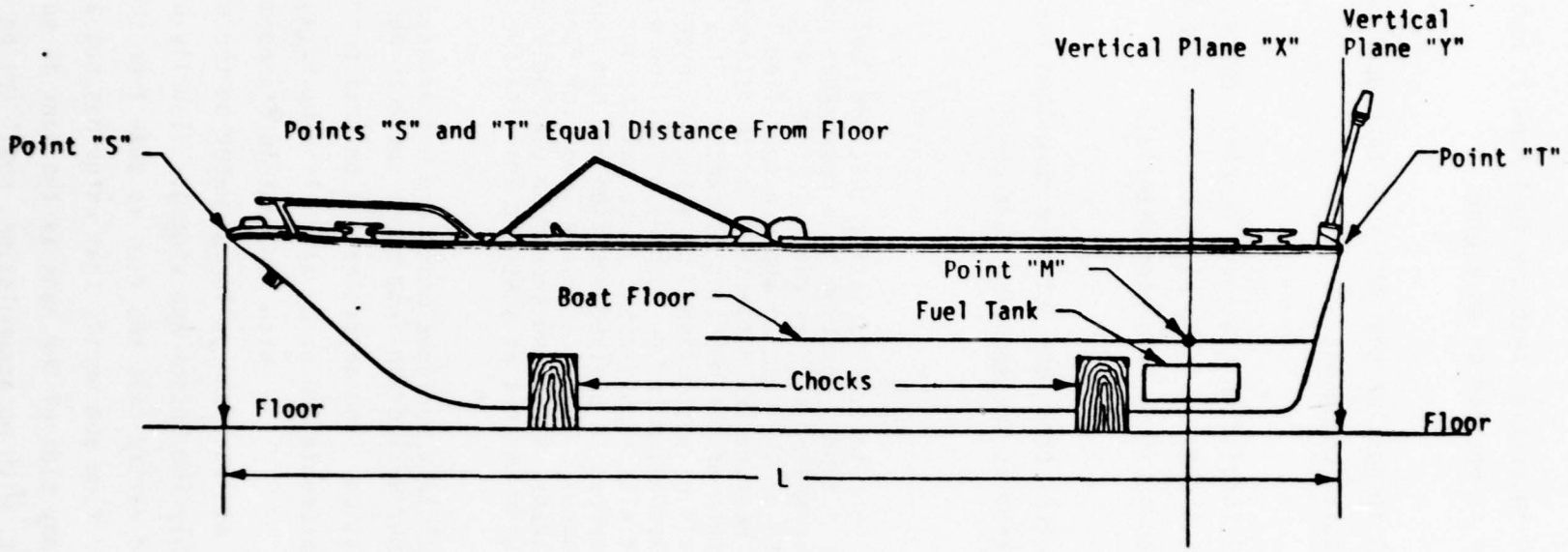


FIGURE 2. DETERMINATION OF FUEL TANK LOCATION

12.4.4 Verify by visual inspection that the fuel tank is not an integral part of the boat structure or is mounted on an engine.

12.4.5 Verify by visual inspection that the fuel tank does not support a deck, bulkhead or other structural component.

12.4.6 Verify by visual inspection that each support, chock, or strap for metallic fuel tanks that is not an integral part of the tank is insulated from the tank surface by a non-moisture-absorbing material.

12.4.7 Verify that the fuel tank does not move more than one-quarter (¼) of an inch in any direction at the mounting surface.

NOTE

The intent of this test is to verify that the fuel tank is secured in its intended position to a reasonable degree by some acceptable method such as chocks, straps, etc. It is not the purpose of the test to apply a specified load in a direction and measure the deflection, or to determine the absolute strength of the mounting mechanism. This test, therefore, shall be accomplished by visually inspecting the mounting mechanism and by pushing or pulling with the hands and arms with a sufficient force only to verify that the tank is secured in a fixed position and not loose and free to move about. The ¼ inch is allowed for flexing the tank walls, straps, etc., and should be used only as a qualitative guide and not as a strict quantitative measurement.

12.4.8 For metallic fuel tank surfaces which are not encased or covered with plastic, verify that water will drain from these surfaces when the boat is in its static floating position. The determination on this position may be verified from previous testing documentation or by accomplishing Paragraph 7.1.4.

With the boat in its normal unloaded static floating position, pour at least one gallon of water on the exposed surfaces (over the top and possibly the bottom and sides). Visually observe the water flow during the test and verify that the flow is away from the tank. Observe the tank after the water flow and verify that water has not accumulated on top of the tank, or on any side of the tank if the tank is so constructed. A surface that is only wet, with no accumulation, shall not be construed as a

failure. Loose foam placed against the tank will hold water against the tank surface by capillary action, and is not acceptable.

12.4.9 Verify by visual inspection that cellular plastic foam is not the sole support for a metallic fuel tank.

12.4.10 Determine by visual inspection whether or not cellular plastic foam is the sole support of a non-metallic fuel tank.

If it is the sole support, verify that the cellular plastic foam has been tested to the requirements of section 183.516(b) or (c) of the Fuel System Standard at a previous time or accomplish the applicable test at this time.

12.5 Bond Uniformity Test

12.5.1 If a metallic fuel tank is encased in cellular plastic or in fiber reinforced plastic, verify that water will not collect between the plastic and the surface of the tank or be held against the tank by capillary action by performing the following test for uniformity of the bonding process:

NOTE

It may be necessary to remove the fuel tank from the boat to accomplish this test. Care should be taken not to damage the plastic.

12.5.2 Seal the fuel feed line and the fuel vent pipe by capping or plugging. Using a suitable pressure adapter, pressurize the tank to 3 to 3¼ psig through the fuel fill pipe. Hold this pressure for one minute and then vent the tank to 0.5 psig or less. Repeat this pressurization/vent cycle 10 times.

12.5.3 Locate a perimeter junction of the plastic and metal that already exists on the tank installation or cut a straight line junction through the plastic at a suitable location on the tank. In either case the junction should be at least 12 inches in length (See Figure 3) with a cleared portion at least one inch wide. Use a one inch putty knife or wood chisel, or an equivalent tool. This should be done at five (5) locations on the tank's surface. One location should be on the bottom surface of the tank. The other four locations should be on different sides of the tank if possible or at least separated from each other as far as possible.

12.5.4 Clear a portion of the plastic from the tank 12 inches in length parallel to the original junction and at least one inch in width. Allow a space of one inch between this second cleared area and the original cleared area (See Figure 4). Use a one inch putty knife or wood chisel, or an equivalent tool as available. Do this for all five test areas.

12.5.5 Using an applicator (such as a paint brush, eye dropper, etc.) apply a generous coat of dye solution (red or black ink is recommended) at the 12 inch junction line between the plastic and the metal. The tank should be positioned such that the dye solution tends to penetrate the bond between the plastic and the metal tank towards the second cleared area.

12.5.6 Wait about 10 minutes and then apply a generous second coat of the dye solution at the junction, similar to the first application.

12.5.7 Allow the tank to set in this position for one hour. Then wipe or soak up any excess dye colored water using a clean rag or towel.

12.5.8 Visually inspect the tank metal and the bonding layer of this last cleare area for any indication that the dye colored water penetrated the bonding layer between the metal tank and the plastic. Any such indication shall be cause for rejection of the tank installation.

12.5.9 Repeat the above test (Paragraphs 12.5.5 through 12.5.8) on the other four test areas.

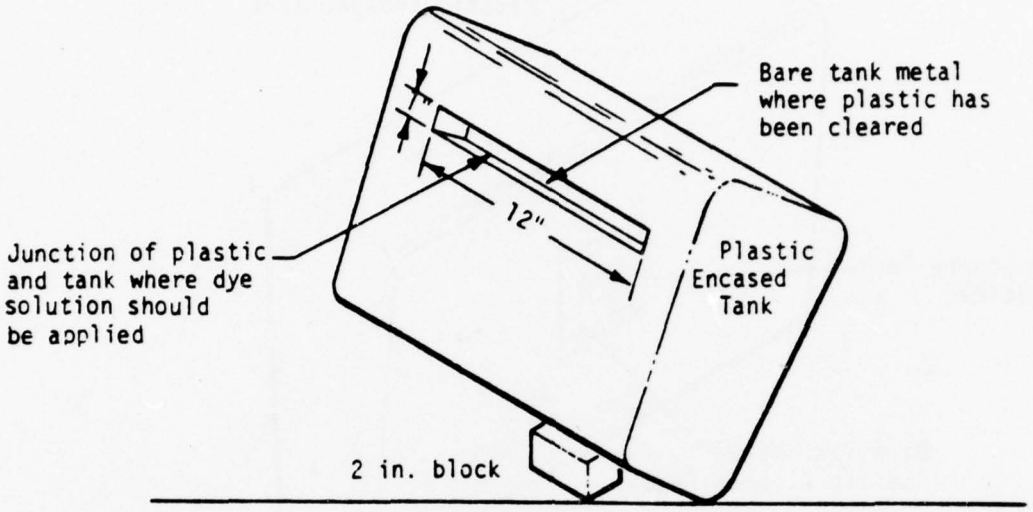
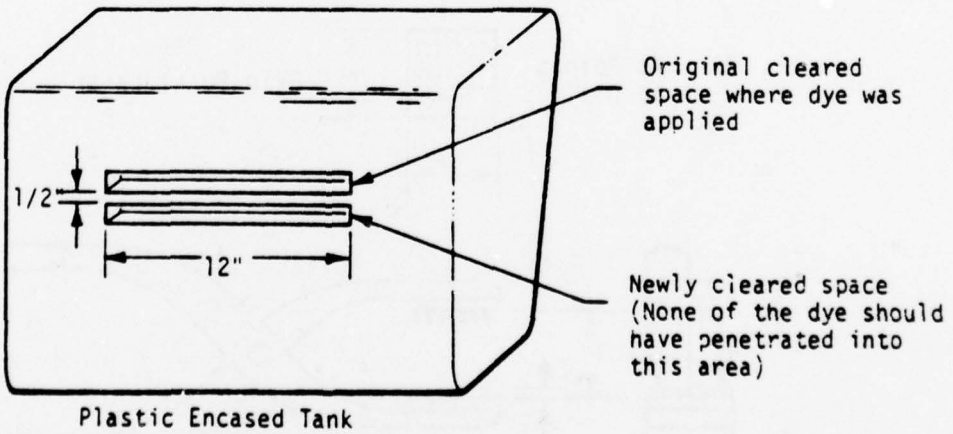
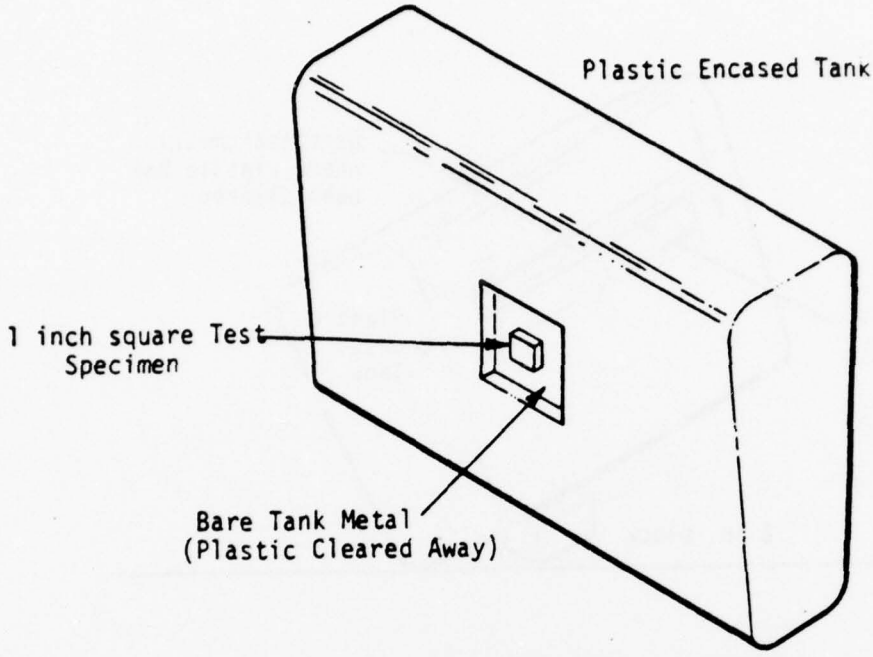


FIGURE 3. BOND UNIFORMITY TEST



SAME TANK AS IN FIGURE 3 EXCEPT VIEW IS STRAIGHT AHEAD.

FIGURE 4. BOND UNIFORMITY TEST



EXAMPLE OF ONE TEST SPECIMEN FOR ALL THICKNESSES OF PLASTIC

FIGURE 5. BOND STRENGTH TEST

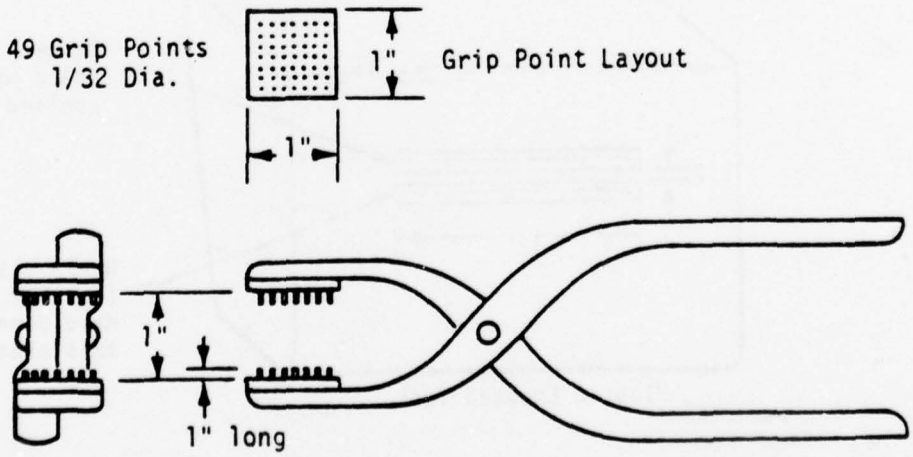


FIGURE 6. SPECIAL TEST TOOL FOR PULLING PLASTIC FOAM

12.6 Bond Strength Test

12.6.1 If plastic is bonded to the surface of a metallic tank, verify that the adhesive strength of the metal to plastic bond exceeds the cohesive strength of the plastic material by performing the following test. The lower limit of acceptability shall be 80% of the test surface showing evidence of cohesive failure.

NOTE

It will be necessary to remove the fuel tank from the boat to accomplish this test if the tank has not been removed already. Care should be taken not to damage the plastic.

12.6.2 Verify that the pressurization/vent cycle test has been completed (Paragraph 12.5.2). Do not repeat this test again.

12.6.3 Remove the excess plastic from around the perimeter of a one inch square at five locations on the tank's surface (See Figure 5). One location shall be on the bottom surface of the tank. The other four locations should be on different sides of the tank if possible or at least separated from each other as far as possible. In no case should any of the five test squares be less than 6 inches from each other.

NOTE

Care should be taken not to damage the plastic in any of the five test squares when removing the excess surrounding plastic. The test squares should be free of any visible flaws or imperfections. The cleared areas used for Paragraph 12.5 can be modified for use in this test. The only difference between Paragraph 12.7 and 12.8 is the tool required. In some cases for both paragraphs use of fingers may be the best method.

12.7 Test -- Plastic 1 inch thick or more

12.7.1 Using the special test tool (see Figure), if available, or a standard pair of 12½ in. or 16 in. arc joint pliers, grip one of the 1 inch square test specimens. The ends of the tool's jaws should touch the tank's surface. Apply a pulling force normal to the tank's surface while at the same time applying a slight back and forth motion to the handle of the tool until either an adhesive failure of the bond or a cohesive failure of the plastic occurs. A

slight increase in the normal applied force may be required. The specimen shall not show an adhesive failure prior to a cohesive one (i. e. the plastic shall tear before it comes loose from the tank).

12.7.2 Repeat the above test (Paragraph 12.7.1) on the other four test specimens. Four out of five of the test specimens must pass the above test in order for the tank to be accepted.

12.8 Test -- Plastic less than 1 inch thick

12.8.1 Using a spatula, putty knife or a sharp chisel as a wedge, attempt to separate the total thickness of one of the 1 inch square test specimens. Care should be taken not to slice through the tank's surface, through the bonding layer or through the plastic layer. As in Paragraph 12.7.1 the object is to cause a failure of the plastic or the bond due to a tensile force and not solely bacause of cutting or slicing. The 1 inch square specimen shall not show an adhesive failure of the bond over more than 20% of the area prior to a cohesive failure of the plastic.

12.8.2 Repeat the above test (Paragraph 12.8.1) on the other four test specimens. Four out of the five test specimens must pass the above test in order for the tank to be accepted.

12.9 If the fuel tank installation successfully passes the above bond strength test (the final test in this procedure) and has not failed any of the previous tests or inspections as prescribed by this procedure, the fuel tank installation shall be deemed acceptable according to the requirements of this procedure.

13.0 LAB EXAMINATION NO. 9 -- FIRE TEST OF FUEL TANKS

183.590(a)(3) and (e)

(a) A piece of equipment is tested under the following conditions and procedures:

(3) Fuel tanks must be tested filled with fuel to one-fourth the capacity marked on the tank in a fire chamber or in an actual or simulated hull section.

(e) If a fuel tank is being tested in an actual or simulated hull section, the actual or simulated hull section must be of sufficient size to contain enough heptane to burn for 2½ minutes in a place adjacent to the tank.

13.1 Test -- Fire test of fuel tanks

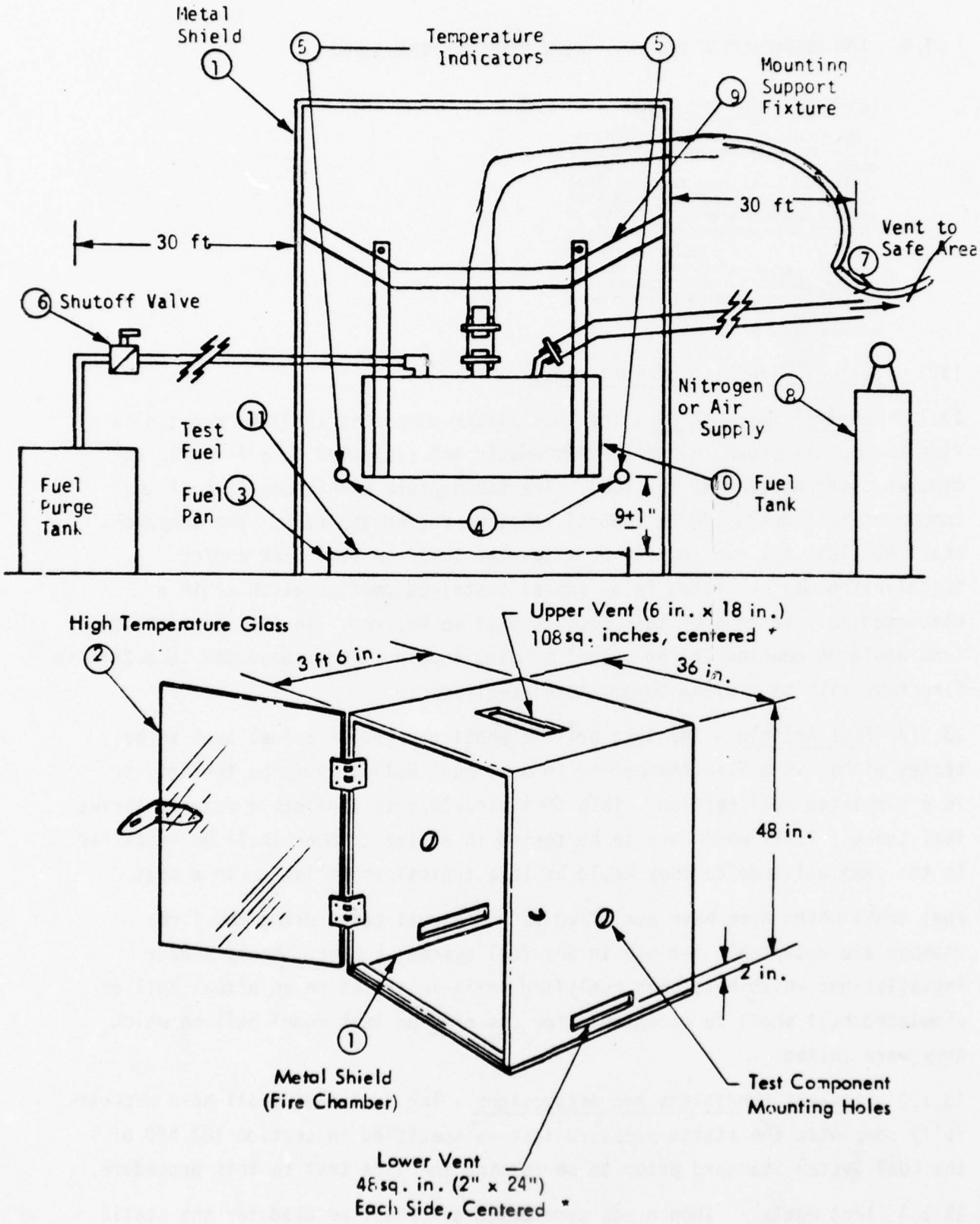
13.1.1 General Description - The fuel system component shall be mounted in a fire chamber as shown in the Test Schematic and subjected to a fire for 2½ minutes using heptane as the fuel. The temperature within one inch of the component must reach 1200°F (648°C) sometime during the test. The component shall not leak any fuel during or after the test. A fuel tank and/or installation may be tested in an actual installed configuration or in a simulated hull section by this procedure if so desired. In this case the fuel tank would be mounted in the actual or simulated hull and subjected to a 2½ minu fire test with no minimum temperature requirement.

13.1.2 Test Article - The test article shall consist of a fuel tank to be tested either in a fire chamber or in an actual hull or portion thereof, or in a simulated hull section. This test procedure is applicable only to marine fuel tanks. Tanks which are to be tested in a fire chamber shall be installed in the same attitude as they would be in a typical installation in a boat.

Fuel tanks which have been qualified as individual tanks using the fire chamber are acceptable for use in any fuel system, however, tanks and/or installations which have been qualified while installed on an actual hull or simulated hull shall be acceptable for use only on that model hull on which they were tested.

13.1.3 Pre-Test Conditions and Assumptions - The fuel tank shall have successfully completed the static pressure test as specified in section 183.580 of the Fuel System Standard prior to performing the fire test in this procedure.

13.1.4 Test Media - Shop grade compressed air shall be used for the static pressure test prior to the actual fire test. No specific analysis is required although the system used should be reasonably clean and not contaminated. Gaseous nitrogen is preferred, however, for the static pressure test after the fire, since gasoline is present in the test system. Heptane shall be used.



TEST SCHEMATIC PROCEDURE

FIGURE 1. FIRE CHAMBER TEST

* For 14 in. x 32 in. Fuel Pan

13.2 Test Equipment and Schematic

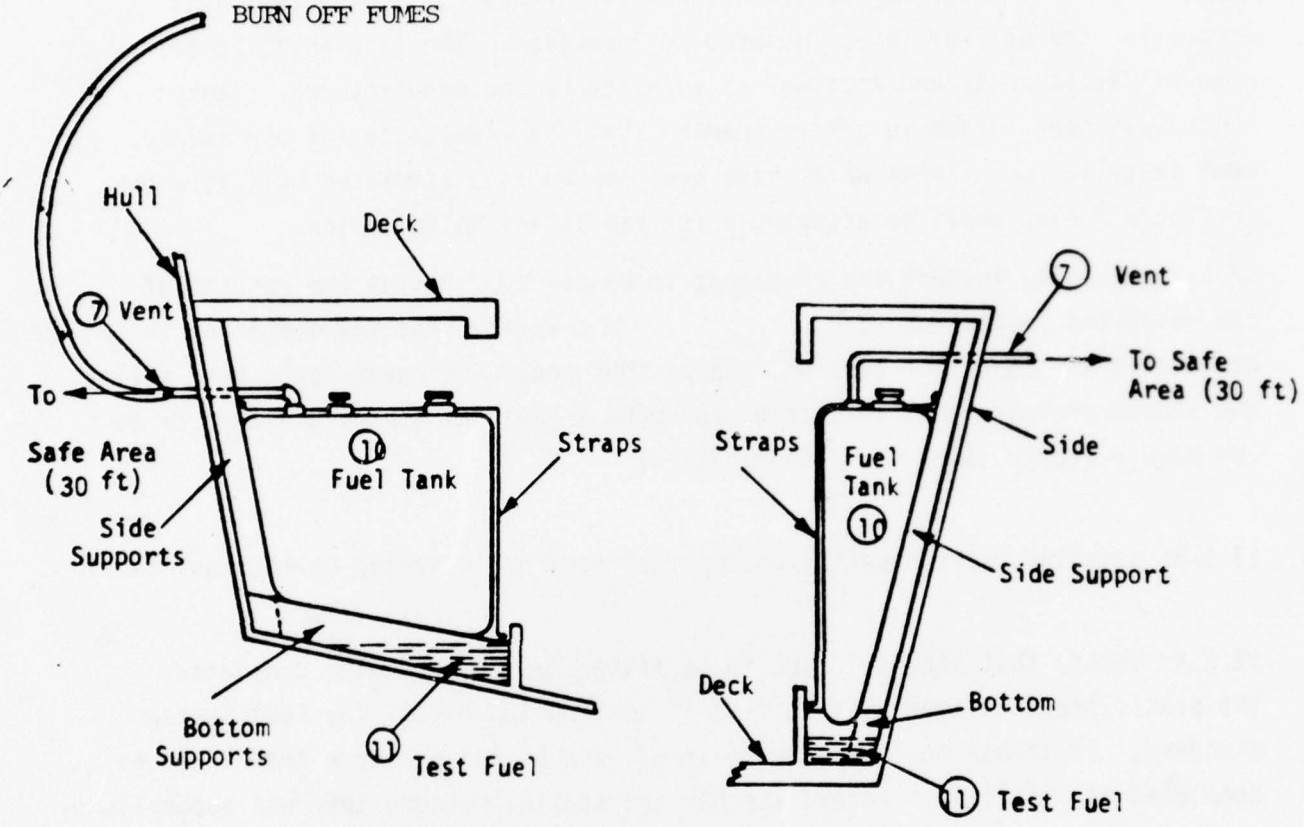


Figure 2 - Simulated hull section test

This test shall be performed on a fuel tank as it is actually installed in a particular hull or portion thereof, or on a tank installed in a simulated hull section. The above illustrations are examples of simulated hull sections.

TEST SCHEMATIC PROCEDURE

13.3 Test -- Fire Test of Fuel Tank

13.3.1 This procedure shall be used to perform a fire test on marine fuel tanks only. The tanks may be tested in a fire chamber, in an actual hull or portion thereof, or in a simulated hull section. The tank shall be tested with all attachments and fittings as supplied by the manufacturer. Tanks which have been tested in a fire chamber shall be acceptable for use in any boat installation. Tanks which have been tested in a simulated hull as shown in Figure 2 also shall be acceptable for use in any installation.

13.3.2 Visually inspect the component to be tested. Review the results of the Receiving Inspection and verify that the component is acceptable and ready for testing. Tanks that would obviously leak, have failed the static pressure test in section 183.580 of the Fuel System Standard or do not have a proper label shall be rejected.

13.3.3 Note the rated capacity of the fuel tank as indicated on the tank label.

13.3.4 Verify that the fuel tank to be tested has successfully completed the static pressure test as specified in section 183.580 of the Fuel System Standard. If it has not been accomplished, the static pressure test shall be completed at this time. Record whether the static pressure test was accomplished at this time or was accomplished previously.

13.4 Fire Chamber Test -- (See Test Schematic Figure 1)

13.4.1 Verify that the tank is empty (less than 1 gal. [3.8 l]).

13.4.2 Mount and secure the fuel tank to the mounting support fixture using two steel straps located within 3 in. (7.6 cm) of the ends of the tank.

NOTE

No straps or other binding should be used in the center portion of the tank which would restrict or limit any expansion of the tank during the test.

The tank shall be secured or suspended in such a manner that the bottom of the tank (or lowest point) shall remain 9±1 in. (22.9±2.5 cm) above the liquid heptane surface after the fuel tank has been filled to ¼ capacity with gasoline.

13.4.3 Connect a hardline (copper tubing) from the tank fuel feed adapter

to a fuel purge tank 30 ft (9.1 m) from the fire chamber. The purge tank shall have a capacity sufficient to hold a quantity of gasoline equal to at least ¼ the capacity of the fuel tank being tested. A shutoff valve shall be installed in the hardline near the purge tank. Verify that the hand valve is in the closed position. Use no sealant or lubricant on the connections or fittings located within the fire chamber.

13.4.4 Fill the fuel tank to ¼ of its rated capacity as determined in Paragraph 13.3.3 using any ordinary pump gasoline. Record the amount of gasoline used.

13.4.5 Vent the fuel tank fill pipe.

13.4.6 Connect a flexible vent hose or copper tubing of proper diameter (minimum diameter allowed 9/16 in. I.D.) to the fuel tank vent pipe. The hose should be long enough to run from the tank to a safe vent area 30 ft (9.1 m) away from the fire chamber. At least the portion of the vent hose which is located within the fire chamber shall be constructed of high temperature fire resistant material (such as USCG Type A hose). Use no sealant or lubricant on the connection within the fire chamber.

13.4.7 Connect a regulated air supply (K-bottle or equivalent) to the end of the vent hose and slowly pressurize the fuel tank to 3 psig (read at the regulator outlet supply pressure gauge). Using a leak detection solution, check for leakage at the fuel feed adapter connection, the vent line connection and any other areas or parts considered to be likely leakage sources. Any leakage found in the test equipment or connections shall be corrected before proceeding with the test. No leakage is allowed.

NOTE

It is imperative that all hoses and fittings within the fire chamber do no leak or fail during the test since this may result in erroneous tank failure indications and/or invalidate the test.

13.4.8 Position a fuel pan directly under the fuel tank. The pan shall be approximately 1 to 1½ in. (3.8 cm) deep and its perimeter shall extend 2 in. (5.1 cm) beyond the vertical projection of the perimeter of the fuel tank being tested.

13.4.9 Fill the fuel pan with heptane to a depth sufficient to burn for 2½ minutes (approximately ½ in. [1.3 cm]). Measure the height from the bottom of the fuel tank being tested to the liquid surface of the heptane. This height shall be 9±1 in. (22.9±2.5 cm).

13.4.10 Position two thermocouples even with the lowest point of the test component, one on each side, within 1 in. (2.5 cm) of the component, as shown in the Test Schematic. The thermocouples shall be capable of measuring 1200°F (648°C) at a remote station.

13.4.11 Place the high temperature glass shield or metal door in position and secure it.

13.4.12 Remove the air supply from the vent line and secure the end of the vent line and fill line in a safe area 30 ft. (9.1 m) from the fire chamber. The line should be left open to allow fuel tank venting during the fire test.

13.4.13 Verify that the system is ready for testing and that all safety precautions are being observed. Two CO_2 fire extinguishers or equivalent should be ready.

CAUTION

All personnel performing this test should maintain a distance of at least 30 ft (9.1 m) between themselves and the fire chamber and preferably 100 ft (30.5 m whenever possible. The person igniting the heptane should retreat to at least 30 ft (9.1 m) immediately after the heptane starts to burn.

13.4.14 With all other personnel at a safe distance from the fire chamber, one person shall ignite the heptane in the fuel pan through one of the vent holes using a 3 ft (0.9 m) torch and allow it to burn for 2½ minutes. It is desirable to continuously record the temperatures encountered during the burn period, however, in no case should the recording interval exceed 15 seconds. During the 2½ minutes, one temperature indication of at least 1200°F (648°C) shall be required at one of the two positions. Record the highest temperature observed during the test on Data Form No. 2, Part A-8. Visually monitor the test system to the extent possible during the burn period for any indication of gasoline leakage. No leakage is allowed.

NOTE

Even though leakage is observed during this part of the test, the rest of the test shall be accomplished to verify the actual point of leakage is in the fuel tank and not part of the test setup.

13.4.15 Verify that there has been 2½ minutes of burn time and then extinguish the fire using CO_2 or Halon. Do not approach the fire chamber for at least 30 seconds after extinguishing the fire.

Approach the chamber with caution and use a portable CO_2 or Halon fire extinguisher to extinguish any remaining flame.

NOTE

Due to the safety requirements of the test, a remote CO_2 or Halon extinguishing system will probably be required for the primary system.

13.4.16 Open the shutoff valve to the gasoline purge tank and connect a regulated GN_2 supply to the end of the vent line (verify the venting of vaporized gasoline has almost ceased). Seal the fill. Slowly pressurize the fuel tank to ¼psig (read at regulator outlet supply pressure gauge).

Maintain ¼ psig and perform a leak test on the fuel tank using a leak detection solution. There shall be no leakage allowed from the fuel tank itself. Sending unit leakage is permissible. Test connections should not be checked. If any leakage from the tank itself is detected, the fuel tank shall be rejected.

If no leakage is observed, the fuel tank shall be deemed acceptable according to the requirements of this procedure for installation in any boat.

13.4.17 Secure the test system as required and safe the area.

13.5 Installed Test -- (See Test Schematic Figure 2)

13.5.1 When a fuel tank is to be tested in an actual hull or portion thereof, or in a simulated hull section, the following initial conditions and/or modifications shall be completed to meet the requirements of the test:

13.5.1.1 An actual hull or section of actual hull shall be positioned in a

level configuration such that the containment of the heptane for 2½ minutes shall not present a limitation or unnecessary constraint on the accomplishment of the test.

13.5.1.2 A simulated hull section shall be constructed as nearly identical to the actual hull configuration as possible, especially in the area of dimensions. The fuel tank shall be mounted in the same manner using similar hardware as that of the actual installation being simulated.

13.5.1.3 A hardline (copper tubing) shall be connected to the fuel feed adapter and run 30 ft (9.1 m) from the fuel tank to a purge tank. The purge tank shall have a capacity sufficient to hold at least ¼ the capacity of the fuel tank being tested. A shutoff valve shall be installed in the hardline near the purge tank. The hand valve should be in the closed position initially.

13.5.1.5 The fuel tank vent line shall be extended (or replaced with another hose) 30 ft (9.1 m) from the hull section to a safe area. Use only vent hose similar to that which would be used in the actual installation which is being simulated. Use no sealant or lubricant on any connections within the hull section.

13.5.1.6 Both the fill line and the vent line located within the flame area shall be routed and restrained in a manner similar to the actual tank installation which is being simulated.

NOTE

It is required that the hose used for both the fill line and the vent line be constructed from the same type of hose or material that would be used in the actual installation and that they be routed and restrained in a similar manner. Since there is no temperature requirement for this test and the conditions can vary to such a great extent, the system (tank and lines) shall be tested as a whole to the extent a failure of any part would contribute to an actual failure of the tank itself.

13.5.1.7 Approximately ½ in. (1.3 cm) of heptane must be contained under the

fuel tank in order to complete the test. The area under the vertical projection of the fuel tank, therefore, must be sealed and made leakproof to the extent necessary to contain the burning heptane for the required 2½ minutes. Any means may be used to accomplish this, however, placement of a metal fuel pan or fuel pans under the fuel tank is the surest method to obtain the 2½ minute burn time.

13.5.1.8 A preliminary leak test of the system shall be accomplished by connecting a regulated air supply to the end of the vent hose and slowly pressurize the fuel tank to 3 psig as read at the regulator outlet supply pressure gauge. Using a leak detection solution, check for leakage at the fuel feed adapter connection, the fill hose connections, the vent line connections and any other areas or parts considered to be likely leakage sources. Any leakage found in the test equipment or connections shall be corrected before proceeding with the test. No leakage is allowed.

If leakage is discovered in the fuel tank itself, the tank shall be rejected and the test terminated.

13.5.1.9 Vent the fuel tank to 0 psig. Fill the fuel tank to ¼ of its rated capacity as determined in Paragraph 13.3.3 using any ordinary pump gasoline.

13.5.2 Fill the sealed area or the metal pan(s) under the fuel tank with heptane to a depth sufficient to burn for 2½ minutes(approximately ½ in. [1.3 cm]).

13.5.2.1 Remove the air supply from the vent line and secure the end of the vent line and fill line in a safe area 30 ft (9.1 m) from the fuel tank being tested. The line should be left open to allow tank venting during the fire test.

13.5.2.2 Verify that the system is ready for testing and that all safety precautions are being observed. Two CO_2 fire extinguishers or equivalent should be ready.

CAUTION

All personnel performing this test should maintain a distance of at least 30 ft (9.1 m) between themselves and the fuel tank under test (preferably 100 ft [30.5 m] whenever possible). The person igniting the heptane should retreat to 30 ft (9.1 m) immediately after the heptane starts to burn.

13.5.2.3 With all other personnel at a safe distance from the fuel tank, one person shall ignite the heptane using a 3 ft (0.9m) or longer torch. Allow the heptane to burn for at least 2½ minutes. There is no minimum temperature requirement for this test, however, the fuel tank must be subjected to the burning heptane for at least 2½ minutes. If the test duration of 2½ minutes was not reached, the test shall be invalid and must be repeated unless the tank failed. In this case the fuel tank shall be rejected.

13.5.2.4 Visually monitor the test system to the extent possible during the burn period for any indication of gasoline leakage.

NOTE

Even though leakage is observed during this part of the test, the rest of the test shall be conducted to verify the actual point of leakage is in the fuel tank and not part of the test setup.

13.5.2.5 Verify that there has been 2½ minutes of burn time and then extinguish the fire using CO_2 or Halon. Do not approach the fire chamber for at least 30 seconds after the indicated temperature in the fire chamber has dropped below 1200°F.
Approach the tank with caution and extinguish any remaining flame with a CO_2 or Halon fire extinguisher.

NOTE

Due to the safety requirements of the test, a remote CO_2 or Halon extinguishing system will probably be required for the primary system.

13.5.2.6 Connect a regulated GN_2 supply to the end of the vent line (verify the venting of vaporized gasoline has almost ceased). Slowly pressurize the fuel tank to ¼ psig (read at regulator outlet supply pressure gauge)

Maintain ¼ psig and perform a leak test on the fuel tank using a leak detection solution. There shall be no leakage allowed from the fuel tank itself. Test connections should not be checked. If any leakage from the tank itself is detected, the fuel tank shall be rejected.

If no leakage is observed, the fuel tank shall be

deemed acceptable according to the requirements of this procedure for installation in any model boat or series of boats having the same hull and configuration as that tested.

13.5.2.7 Secure the test system as required and safe the area.

14.0 LAB EXAMINATION NO. 10 -- FUEL TANK STATIC PRESSURE TEST

183.580 Static pressure test for fuel tanks

> A fuel tank is tested by performing the following procedures in the following order:
>
> (a) Fill the tank with air or inert gas to the pressure marked on the tank label under § 183.514(b)(5). The pressure is measured by a calibrated pressure gauge with a pressure range not exceeding three times the test pressure required by this paragraph or by a manometer.
>
> (b) Examine each tank fitting and seam for leaks using a leak detection method other than the pressure drop method.

The requirements of this Lab Examination are prescribed in sections 183.510(a), 183.584(a) and (f), 183.586(a) and (g), and 183.588(a) and (g) of the Fuel Systems Standard.

14.1 Apparatus - Regulated pressure source of either air or nitrogen, manometer and leak detection solution.

14.2 Test Specimens - The fuel tank(s) as received in the boat with all attachments and fittings installed by the tank manufacturer on the tank(s).

14.3 Test Conditions - All openings and fittings in the tank(s) shall be plugged and sealed prior to pressurization.

14.4 Test Procedure

14.4.1 Obtain the test pressure used for the pressure check of the tank from the tank nameplate or the tank manufacturer.

14.4.2 The tank shall be attached to a regulated-pressure source of either air or nitrogen and subjected to the test pressure. The pressure is to be measured by a manometer; a pressure gauge with a maximum range of no more than three times the test pressure may be used, but a pop-off relief valve should be used in conjunction with the pressure gauge to protect against over pressur-

ization which could be hazardous.

14.4.3 All seams, fittings and joints shall be tested for leakage and the fuel tank checked for signs of permanent deformation.

14.4.4 Determination of leakage shall be made utilizing acceptable leak detection methods which include the use of soapy water or a liquid detergent solution applied to all seams, fittings and joints.

14.4.5 There shall be no leakage. Another method of leak detection is to completely submerge the pressurized tank in water and visually inspect it for gas bubbles over 100% of the outer surfaces. The test pressure must be at least 3 psig greater than the hydrostatic pressure of the water at the lowest part of the fuel tank being tested.

15.0 LAB EXAMINATION NO. 11 -- FUEL SYSTEM STATIC PRESSURE TEST

183.582 Static pressure test for fuel systems

A fuel system is tested by performing the following procedures in the following order:

(a) Fill the portion of the system that is between the fuel line connection at the engine fuel inlet and the fill and vent fitting on the boat with air or inert gas to the greater of the following pressures:

(1) Three PSIG.

(2) One and one-half times the pressure created at the lowest point in the fuel system when the fill or vent line, whichever is lower in height, is filled to its top with fuel.

(b) Read the pressure. The pressure is measured by a calibrated pressure gauge with a pressure range not exceeding three times the test pressure required by this paragraph or by a manometer.

(c) Wait at least five minutes and thereafter wait one additional minute for each 10 gallon increment, or fraction thereof, in the tank's capacity greater than 50 gallons.

(d) Read the pressure in accordance with paragraph (b) of this section. A pressure drop measured at the end of the time required by paragraph (c) of this section is due to leakage.

(e) If no pressure drop is measured by the manometer or pressure gauge, then while the system remains pressurized, examine each fuel fitting, joint, and connection except each connection at fill and vent fittings for leaks, using a leak detection method other than the pressure drop method.

NOTE

The requirements of this Lab Examination are prescribed in section 183.542.

15.1 Constraints - Prior to the start of this test the system is required to be at a constant ambient temperature of ±5°F for two hours in order to accomplish the pressure decay test with an acceptable degree of accuracy. Due to outside temperature changes which occur throughout the day, although not required, it is highly desirable to perform the test inside a building where some temperature control is available. The system shall be empty of any gasoline.

15.2 General Description - The system shall be subjected to a pressure decay test. Upon successful completion of this test, each component's fittings, joints and connections shall be leak checked using a leak detection solution or other suitable means capable of detecting extremely small leaks.

15.3 Test Media - Shop grade compressed air or gaseous nitrogen. No special analysis is required. GN_2 is preferred, especially if gasoline has been used in the system prior to this test.

15.4 Test Equipment and Material

Component Find No.	Title	Description
1	Pressurant Supply Bottle	Fuel system pressurant, may be shop grade compressed air or nitrogen.
2	Pressure Regulator	Manually controlled pressure regulator to reduce supply bottle pressure to fuel system test pressure.
3	Supply Valve	Flow control shutoff valve for pressurant supply.
4	Relief Valve	Manually adjustable relief valve to prevent fuel system overpressurization.
5	Pressure Supply Indicator	Pressure gauge readable to 0.25 psi increments or Hg manometer. Note: The pressure gauge shall have a range not exceeding three times the test pressure.
6	Pressure Supply Adapter Assembly	Adapter to seal the fill hose and provide connectors for the pressurant supply, pressure indicator and relief valve.
7	Pressure Indicator	If an auxiliary fuel tank is installed a pressure gauge readable to 0.25 psi or Hg manometer is required to be located in the fill pipe to that tank. Note: The pressure gauge shall have a range not exceeding three times the test pressure.

15.5 Test

15.5.1 This procedure shall be used to perform a pressure test of the fuel system after the entire system has been installed in a boat. It is in addition to any pre-installation component leak tests that may have already been accomplished.

15.5.2 Visually inspect the entire fuel system up to and including the inlet fitting in the carburetor.

Known discrepancies which may be corrected without invalidating the test should

be completed at this time. Verify that the system has been at a reasonably constant ambient temperature for two hours prior to the start of the test and will remain so during the performance of the test. To accomplish this, it is highly desirable, although not mandatory, for the system to be in a controlled atmosphere, such as in a building, rather than outside where the temperature may vary quite rapidly depending on the time of day, sunshine, etc.

NOTE

When accomplishing the following test, it is highly desirable to break into the fuel system in as few places as possible. It is recognized, however, that due to the location or a particular type of fill and vent fittings used, it may be impossible or unreasonably difficult to test the system without breaking the system at the upper end of the fill and/or vent hoses. Therefore, the test has been written with the assumption that these hoses have been disconnected at the boat connect end (not at the fuel tank end). If for a particular boat or installation the test can reasonably be accomplished without breaking the system at one or both of these points, the test should be run in that manner.

15.5.3 Disconnect the fuel feed line at the engine fuel inlet, engine installed fuel pump or filter and install a pressure gauge or a suitable manometer.

15.5.4 Disconnect the fuel tank vent line at the deck fitting and plug the vent hose (the preferred method is to plug the external vent fitting).

15.5.5 Disconnect the fuel tank fill line at the deck fitting and connect the pressure supply adapter assembly to the fill hose (the preferred method is to use a modified fill cap for the adapter).

NOTE

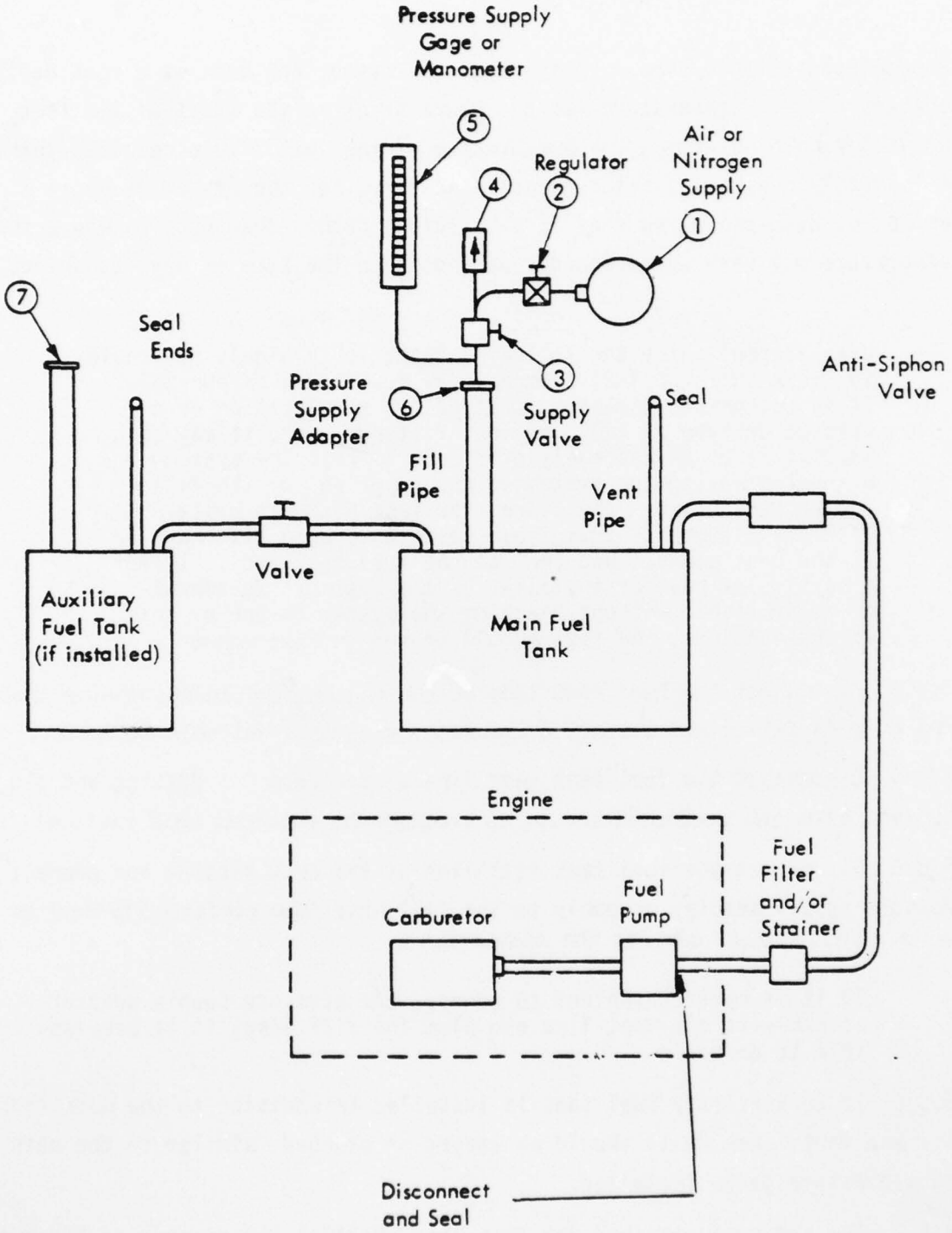
If it is more convenient to connect the pressure supply adapter assembly to the vent line and plug the fill line, it is permissible to do so.

15.5.6 If an auxiliary fuel tank is installed in addition to the main tank, the fill and vent lines on it should be capped or plugged, similar to the main tank, and a pressure gauge installed.

15.5.7 The pressure required for this test shall be the greater of the two pressures as called out below:

a. Three (3) psig

b. One and one-half (1½) times the static head pressure as determined in this manner: measure the vertical height (H) in inches from



PROCEDURE TEST SCHEMATIC

the lowest point in the fuel system to the top of the fill or the vent line, whichever is lower.

If the calculated pressure (0.04 x H in.) is greater than the tank labeled pressure, stop the test.

If H is 75 in. (1.9 m) or less, use 3 psig for the test pressure as called out in part (a) above and record this pressure on Data Form No. 2, Part A-3. If H is greater than 75 in. (1.9 m), the test pressure shall equal .04 (H) psig.

15.5.8 Connect either an air or GN_2 pressure source capable of supplying a regulated pressure of 0 - 10 psig to the pressure supply adapter in the fill hose. A pressure gauge or a manometer shall be connected to a tee in the pressure supply line as close as possible to the pressure supply adapter. A pressure gauge shall have a range not exceeding three times the test pressure as required by Paragraph 15.5.7. The relief valve shall be set at 1.5 ± 0.5 psi above the test pressure as required by Paragraph 15.5.7.

15.5.9 Verify that the system is configured similar to the Test Schematic and is ready for testing:

a. Pressure supply valve closed.
b. Pressure supply regulator fully decreased (ccw).
c. Fuel shutoff valve between main tank and any auxiliary tank full open (if any).
d. Any valve between the main tank and the carburetor full open (if any).

15.5.10 Open the pressure supply valve. Slowly increase the pressure supplied to the system by turning the regulator cw and monitoring the pressure gauge or manometer. Increase the pressure at a rate not to exceed ½ psi per minute until the required test pressure is reached as determined by Paragraph 15.5.7 and indicated on the pressure supply gauge or the manometer.

15.5.11 Maintain this test pressure $\pm$¼ psi for at least 5 minutes and allow the system to stabilize. During this period verify that there is no audible leakage in the system.

NOTE

At any time during the test when leakage is detected, the points of leakage should be noted and documented, and the

NOTE (contd.)

system should be vented to 0 psig. If the leakage is due entirely to the test hardware, the leak shall be corrected and the test rerun starting with Paragraph 15.5.9. If the leakage is in the fuel system and determined to be caused solely by the improper installation of a component as determined by the test engineer (such as a hose clamp left off or a loose B-nut), the installation may be corrected to the proper specification and the test rerun starting with Paragraph 15.5.9. Any discrepancies shall be so documented in the procedure.

15.5.12 Verify that the entire fuel system has been pressurized as evidenced by the pressure gauge readings at the auxiliary fuel tank, if installed, and at the engine fuel inlet. These gauges will not necessarily indicate the same pressure as the pressure supply gauge and there is no requirement for them to do so. The engine fuel inlet pressure gauge may indicate much less than the pressure supply gauge, depending on the anti-siphon valve installed and the other components in the fuel feed line. Any positive indication of pressure is acceptable. If 0 psig is indicated, the test shall be halted until the situation has been examined and the proper corrective action determined by the test engineer.

15.5.13 With the pressure supply gauge indicating the required test pressure $\pm\frac{1}{4}$ psi and stable, close the pressure supply valve and record the pressure indicated. This is the initial pressure decay reading.

15.5.14 Observe the pressure supply gauge or manometer for a period of five minutes for tanks whose fuel capacity is 50 gal. (189.3 l) or less. For tanks over 50 gal. (189.3 l), an additional minute shall be added to the five minutes for each 10 gal. (37.9 l) increment or fraction thereof.

Example: A 61 gal. (230.9 l) tank or a 70 gal. (265 l) tank shall be observed for seven (7) minutes.

At the end of the required time, record the pressure indicated on the pressure supply gauge. This is the final pressure reading. The pressure reading shall have decreased from the initial pressure reading less than $\frac{1}{4}$ psi if a pressure gauge was used or less than 0.5 in. (1.3 cm) if an Hg manometer was used.

15.5.15 If the system pressure has decayed more than allowed from the initial pressure reading, verify no leakage exists in the test hardware using a leak detection solution and reject the fuel system if required by Paragraph 15.5.11. Otherwise, correct the problem and rerun the test starting with Paragraph 15.5.13. Document any discrepancy.

15.5.16 Perform a complete leak test of the entire fuel system using a leak detection solution. The test shall include:

a. fuel tank(s) and vent connections, except at the hull or deck fitting(s)
b. fuel tank(s) fuel indicator fitting
c. fuel tank(s) feed line connection
d. any other connection or fitting on the fuel tank(s)
e. feed line between main tank and an auxiliary tank, if installed, and any valves or components including connections and fittings.
f. feed line between main tank and the carburetor and any valves or components such as anti-siphon valve, shutoff valve, fuel filter and/or strainer, fuel pump including connections and fittings
g. any other line or component which is part of the fuel system.

No leakage in the system is allowed. If leakage is detected, the fuel system shall be rejected. If no leakage is detected, the fuel system shall be deemed acceptable according to the requirements of this procedure. Record whether or not any leakage was found and the location(s)

183.520(a) Fuel tank vent system

(a) Each fuel tank must have a vent system that prevents pressure in the tank from exceeding 80 percent of the pressure marked on the tank label under § 183.514(b)(5).

15.6 Fuel Tank Vent Test

15.6.1 Remove the plug from the vent line and reconnect the vent line to the deck fitting.

15.6.2 Attempt to pressurize the system to 80% of the pressure marked on the tank label.

15.6.3 If the pressure reaches 80% of the pressure marked on the tank label, the vent system shall be rejected.

15.6.4 Secure the system as required. Vent the test pressure to zero (0) psig. Remove all gauges and reconnect all lines and hoses disconnected for the test to the proper specification.

16.0 LAB EXAMINATION NO. 12 -- FUEL TANK SHOCK TEST

183.584 Shock test

A fuel tank is tested by performing the following procedures in the following order:

(a) Perform the static pressure test under § 183.580.

(b) If the tank is non-metallic, fill it to capacity with a gasoline that has at least a 50 percent aromatic content. Keep the fuel in the tank at 21° C or higher for 30 days prior to testing.

(c) Mount the tank to the platform of an impact test machine.

(d) Fill the tank to capacity with water.

(e) Apply one of the following accelerations within three inches of the center of the horizontal mounting surface of the tank. The duration of each vertical acceleration pulse is measured at the base of the shock envelope.

(1) If the tank is not labeled under § 183.514(b)(8) for installation aft of the half length of the boat, apply 1000 cycles of 25g vertical accelerations at a rate of 80 cycles or less per minute. The duration of the acceleration pulse must be between six and 14 milliseconds.

(2) If the tank is manufactured for installation with its center of gravity aft of the half length of the boat, apply 1000 cycles of 15g vertical accelerations at a rate of 80 cycles or less per minute. The duration of the shock pulse must be between six and 14 milliseconds.

(f) Perform the static pressure test under § 183.580.

16.1 General Description - The fuel tank shall be mounted on a test fixture similar to a typical or actual boat installation and subjected to 100 shock cycles using a suitable shock machine. There shall be no leakage of the fuel tank as a result of these applied shocks.

16..1.1 Test Article - The test article shall consist of a fuel tank as delivere by the manufacturer or as removed from an actual installation. The tank shall include all attachments and fittings that would normally be found in such an installation,.i. e. fuel gauge, fuel feed adapter, vent and fill pipes, etc.

16.1.2 Constraints

a. This test applies to tanks with a capacity of less than 25 gallons.

b. Fuel tanks which are labeled under section 183.514(b)(8) of the Fuel System Standard "for installation only in the aft half-length of the boat" shall be tested for 1000 cycles of 15 g vertical acceleration at a rate of 80 cycles per minute.

c. Other tanks shall be tested at 25 g vertical acceleration.

16.1.3 Pre-Test Conditions and Assumptions

a. The Static Pressure Test per section 183.580 shall have been completed successfully.

b. Personnel performing the test shall be reasonably familiar with boat systems and testing practices to accomplish the procedure without undue training required.

16.2 Test Equipment and Schematic

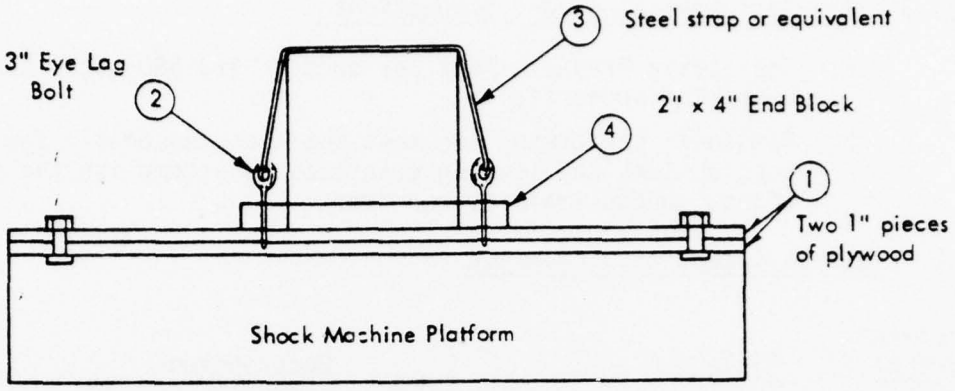
Component Find No.	Title	Description
1	Test Platform	A flat level fixture on which the fuel tank is mounted and secured. The whole assembly is then mounted to a suitable shock machine.
2	Eye Lag Bolts	A bolt used to secure the fuel tank to the test platform.
3	Tie Down Straps	Steel or equivalent straps to hold the fuel tank in position during the test.
4	Positioning Blocks	2 x 4 board or equivalent to maintain the tank in the proper position during the test.
5	Chocks	2 x 6 board or equivalent cut to the contour of the tank to maintain and support the tank in the proper position during the test. For non-flat bottomed tanks only.

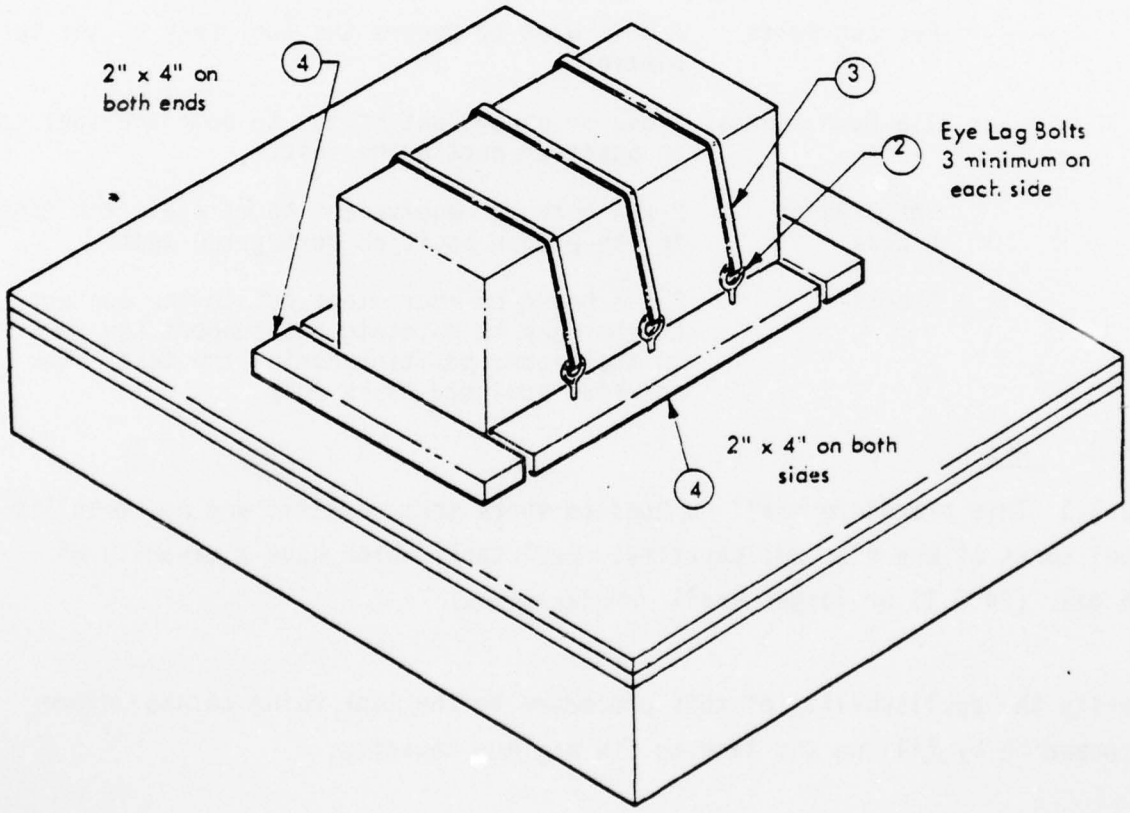
16.3 Test

16.3.1 This procedure shall be used to shock test metallic and non-metallic fuel tanks of any size and capacity. Fuel tanks which have a capacity of 25 gal. (94.6 l) or larger shall not be tested.

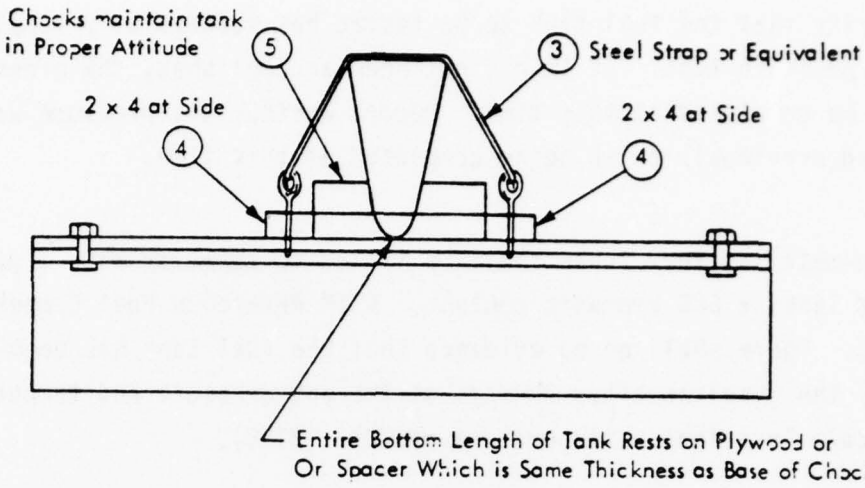
Verify the applicability of this procedure to the tank being tested before proceeding by filling the tank to its maximum capacity.

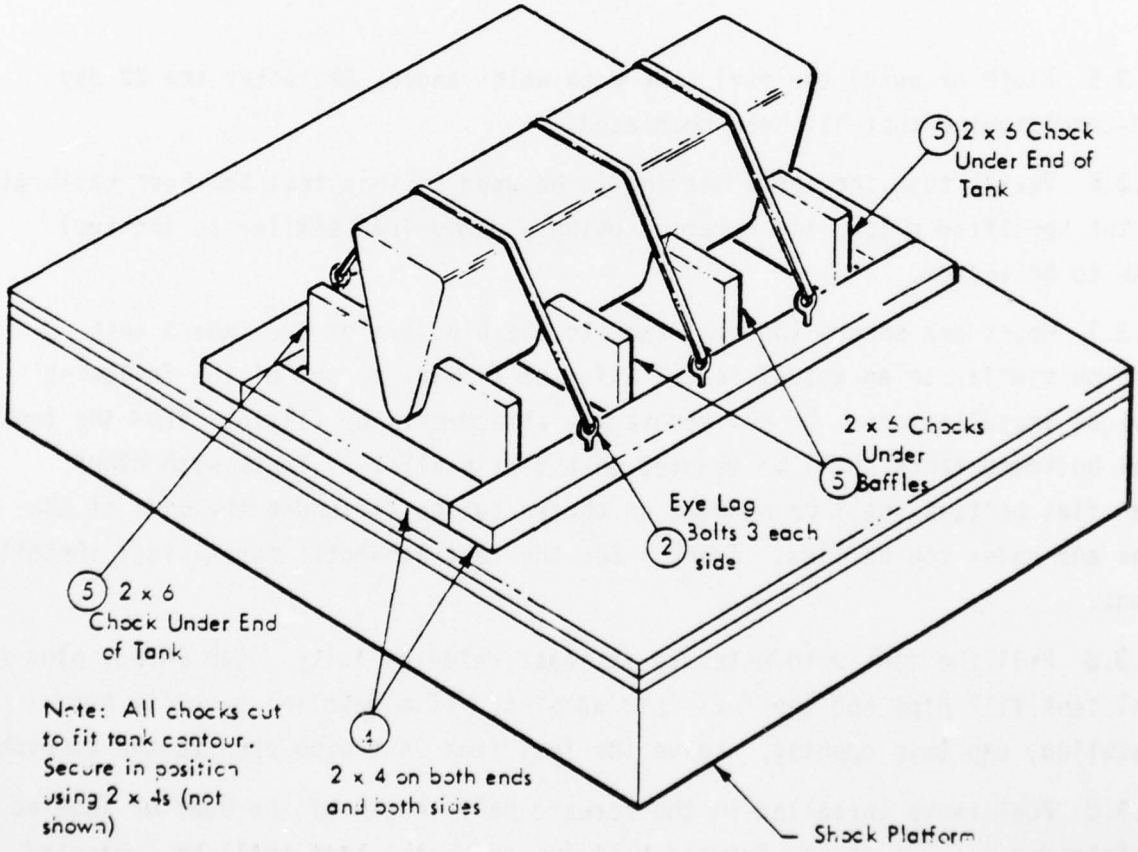
16.3.2 Visually inspect the fuel tank. Review the results of the Receiving Inspection (Data Form No. 1) and verify that the component is acceptable and ready for testing. Tanks that obviously would leak and have failed the pressure test, or those that do not have a proper label shall be rejected.





SHOCK TEST — TYPICAL LAYOUT FOR FLAT BOTTOMED TANK
TEST SCHEMATIC PROCEDURE





SHOCK TEST — TYPICAL LAYOUT FOR NON-FLAT BOTTOMED TANK

TEST SCHEMATIC PROCEDURE

16.3.3 Verify that the fuel tank to be tested has successfully completed the static pressure test. If it has not been accomplished, the pressure test shall be completed at this time. Record whether the pressure was accomplished previously or is being completed at this time.

16.3.4 Non-metallic fuel tanks shall be filled to capacity with a gasoline that has at least a 50% aromatic content. ASTM Reference Fuel C meets this requirement. There shall be no evidence that the fuel tank has been adversely affected by the gasoline after 30 days at ambient pressure and temperature, but in no case less than a temperature of 70°F (21°C).

16.3.5 Flush or purge the fuel tank with water and/or GN_2 after the 30 day pre-conditioning test has been completed.

16.3.6 Verify that the shock machine to be used in this test has been calibrated to the specified g load and duration using a dummy load similar to the fuel tank to be tested.

16.3.7 Mount and secure the fuel tank to the platform of the impact test machine similar to an actual installation or similar to one of the following typical installations. Do not remove any attachments or fittings from the tank. Flat bottomed tanks shall be mounted on a flat platform. Tanks with other than flat bottoms shall be mounted on chocks cut to fit under the ends of the tank and under the baffles, if any. See the Test Schematic for typical installations.

16.3.8 Fill the tank with water to at least rated capacity. Cap and/or plug the fuel tank fill pipe and the fuel feed adapter. If a gasoline gauge is not installed, cap this opening. Leave the fuel tank vent pipe open to the atmosphere.

16.3.9 Fuel tanks installed in the forward half-length of the boat or labeled or intended for use in the forward half-length of the boat shall be subjected to 1000 cycles of 25 g vertical shock. Fuel tanks installed in the aft half-length of the boat or labeled or intended for use in the aft half-length of the boat shall be subjected to 1000 cycles of 15 g vertical shock. When in doubt

about a fuel tank's installation or usage, subject the tank to 1000 cycles of 25 g vertical shock. The duration of the shock pulse, measured at the base of the shock envelope, shall be 10±4 milliseconds. The shock shall be applied at a rate of 80 cycles or less per minute. The test parameters shall be monitored by suitable instrumentation mounted as near to the center of gravity of the fuel tank as possible.

16.3.10 The fuel tank shall be visually inspected after wach shock test has been applied. If any obvious failure has occurred, the fuel tank shall be rejected.

16.3.11 If the tank shows no indication of any leakage after 1000 shock applications, remove the tank from the shock machine and secure the system.

16.3.12 Perform the pressure test on the fuel tank and verify that the tank does not leak. If leakage is found during the test, the tank shall be rejected. If the tank successfully completes the pressure test, the tank shall be deemed acceptable according to the requirements of this procedure.

17.0 LAB EXAMINATION NO. 13 -- FUEL TANK PRESSURE IMPULSE TEST AND SLOSH TEST

183.586 Pressure impulse test

A fuel tank is tested by performing the following procedures in the following order:

(a) Perform the static pressure test under § 183.580.

(b) If the tank is non-metallic, fill it to capacity with a gasoline that has at least a 50 percent aromatic content. Keep the fuel in the tank at 21° C or higher for 30 days prior to testing.

(c) Mount the tank on a test platform.

(d) Fill the tank to capacity with water.

(e) Cap and seal each opening in the tank.

(f) Apply 25,000 cycles of pressure impulse at the rate of no more than 15 impulses per minute varying from zero to three PSIG to zero inside the tank top from a regulated source of air, inert gas, or water.

(g) Perform the static pressure test under § 183.580.

NOTE

The requirements of this test are prescribed by sections 183.510(d) and (e) and 183.588(b).

183.588 Slosh test

A fuel tank is tested by performing the following procedures in the following order:

(a) Perform the static pressure test under § 183.580.

(b) Perform the pressure impulse test under § 183.586.

(c) Secure the tank to the platform of a tank rocker assembly.

(d) Fill the tank to one-half capacity with water.

(e) Cap and seal each opening in the tank.

(f) Apply 500,000 cycles of rocking motion 15 degrees to each side of the tank centerline at the rate of 15 to 20 cycles a minute. The axis of rotation of the rocker and fuel tank must be perpendicular to the centerline of the tank length at a level six inches or less above or below the tank's bottom.

(g) Perform the static pressure test under § 183.580.

NOTE

The requirements of this test are prescribed by section 183.510(e).

17.1 General Description - The tank shall be subjected to a static pressure test, if not previously accomplished, to verify that the tank has zero leakage. 25,000 pressure impulses shall be applied to the tank or until leakage is observed. If the tank successfully completes the pressure impulse test, it shall then be subjected to a slosh test for 500,000 cycles. The fuel tank shall have no leakage as a result of these tests as determined by the final static pressure test.

17.1.1 Test Article - The test article shall consist of a fuel tank as delivered by the manufacturer or as removed from an actual installation. The tank shall include all attachments and fittings as would normally be found in an installation such as a fuel gauge, fuel feed adapter, vent and fill pipes, etc.

17.2 Constraints -

a. The pressure impulse test is only for fuel tanks which have a capacity of 25 gal. (94.6 l) or more.

b. Tanks which have a capacity of 100 gal. (378.5 l) or more are required to pass the pressure impulse and the slosh test.

TANK SIZE

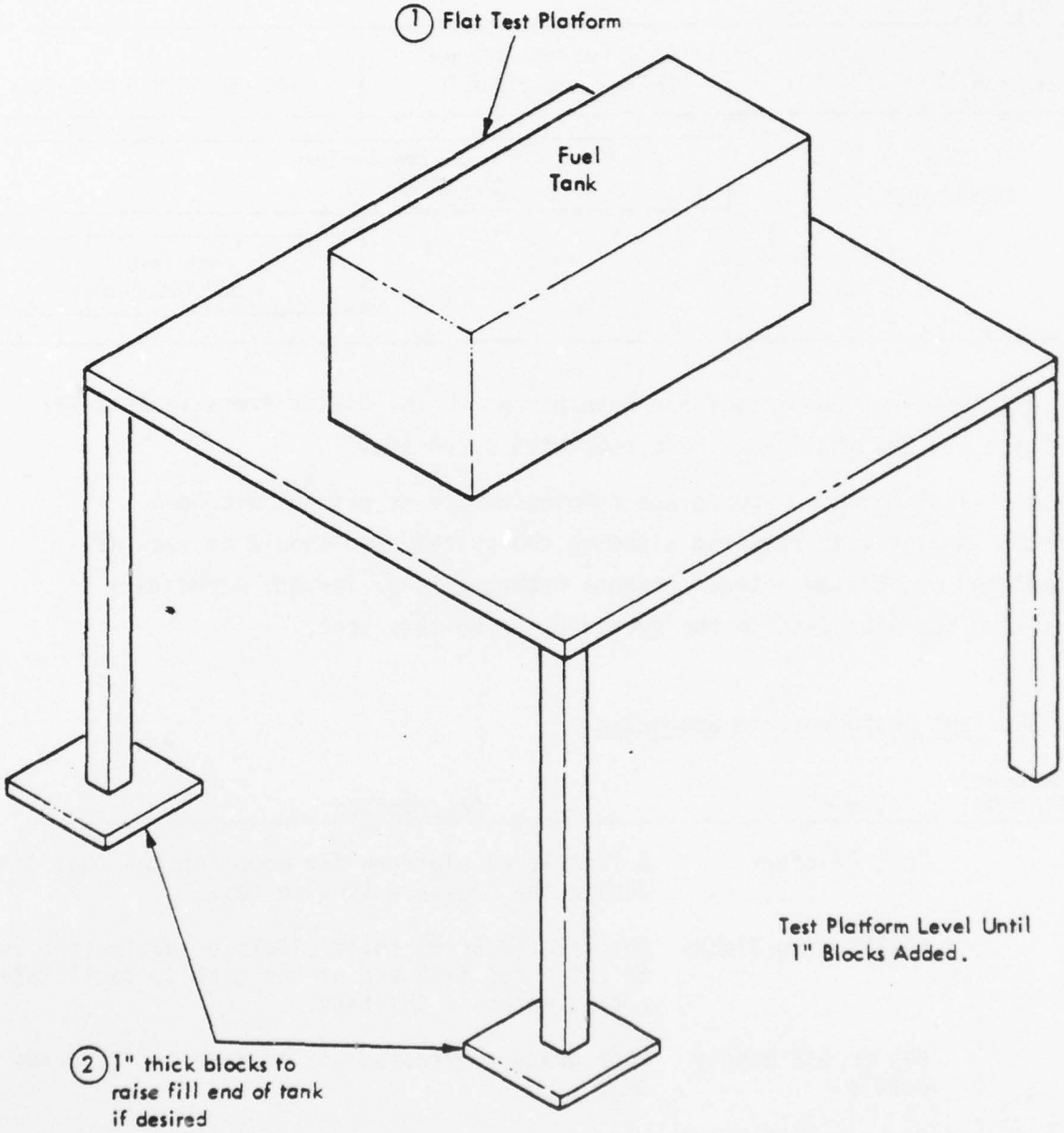
Less than 25 gal. (94.6 l)	25 to less than 100 gal. (94.6 l to < 378.5 l)	100 gal. (378.5 l) or more
NOT APPLICABLE	Pressure Impulse Test 25,000 Cycles	
		Slosh Test 500,000 Cycles

17.2.1 Pre-Test Conditions and Assumptions - The Static Pressure Test per section 183.580 shall have beem completed successfully.

17.2.2 Test Media - Shop grade compressed air or gaseous nitrogen. No special analysis is required although the system used should be reasonably clean and not contaminated. Gaseous nitorgen is preferred, especially if gasoline has been used in the system prior to this test.

17.3 Test Equipment and Schematic

Component Find No.	Title	Description
1	Test Platform	A flat level platform for mounting the fuel tank during the pressure impulse test.
2	Positioning Blocks	One inch (2.5 cm) thick blocks or equivalent used to raise the fill end of the tank to facilitate adding water to the tank.
3	GN_2 or Air Supply Bottle	Shop grade compressed air or high purity grade GN_2.
4	Pressurant Supply Valve	Flow control shutoff valve to control the air or GN_2 gas supply to the system.
5	Supply Pressure Gauge	A pressure gauge to monitor the inlet supply GN_2 or air pressure to the system. Range 0 - 100 psig
6	Regulator	A hand regulator used to regulate the inlet pressu to the required test level (3 psig).



PRESSURE IMPULSE TEST — TYPICAL LAYOUT FOR FLAT BOTTOMED TANK

TEST SCHEMATIC PROCEDURE

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FUEL SYSTEM STANDARD TEST PROCEDURE.(U)
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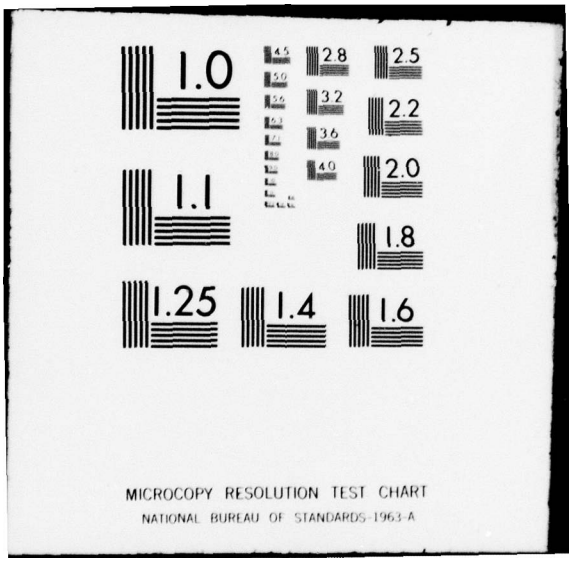
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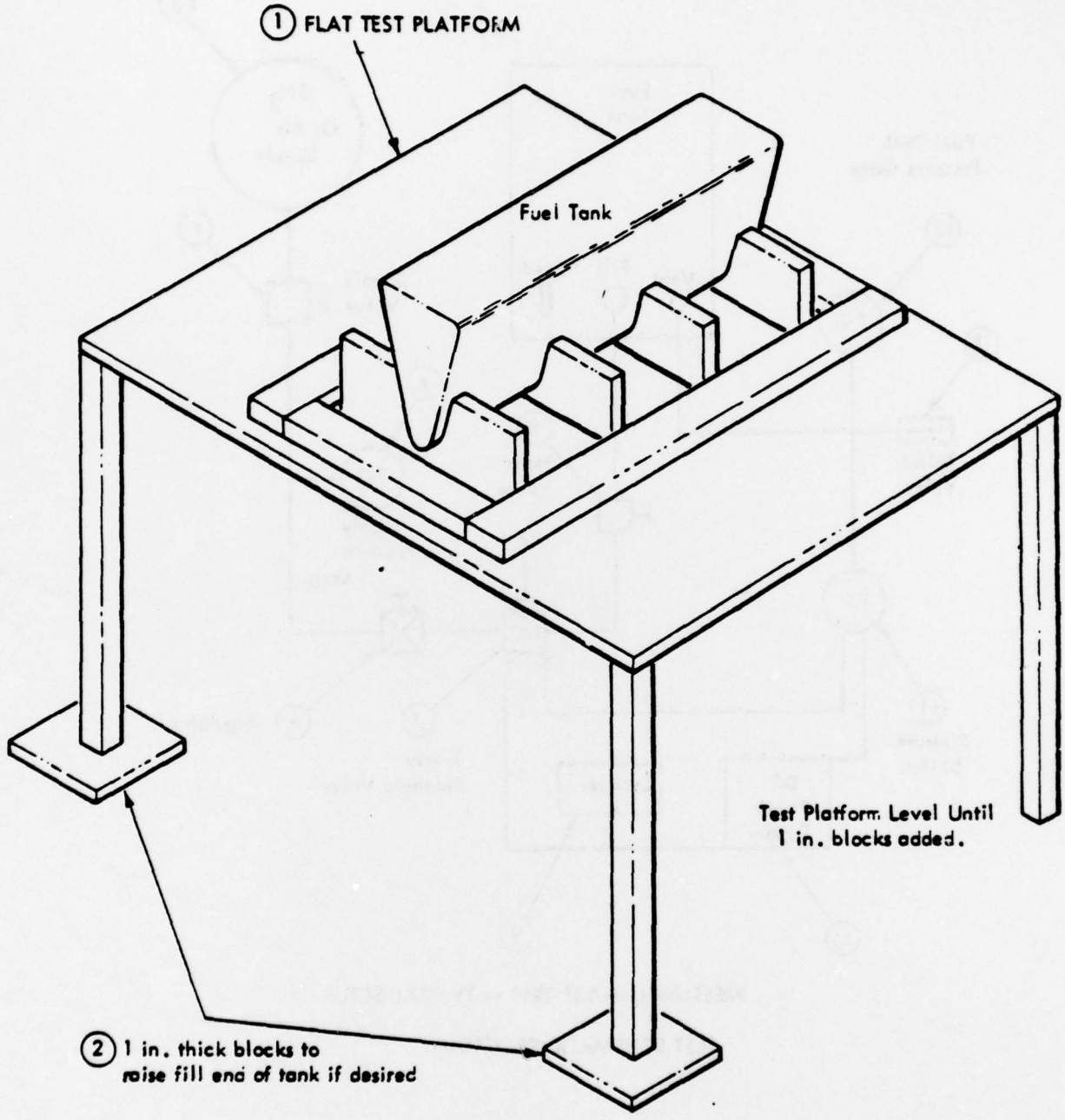
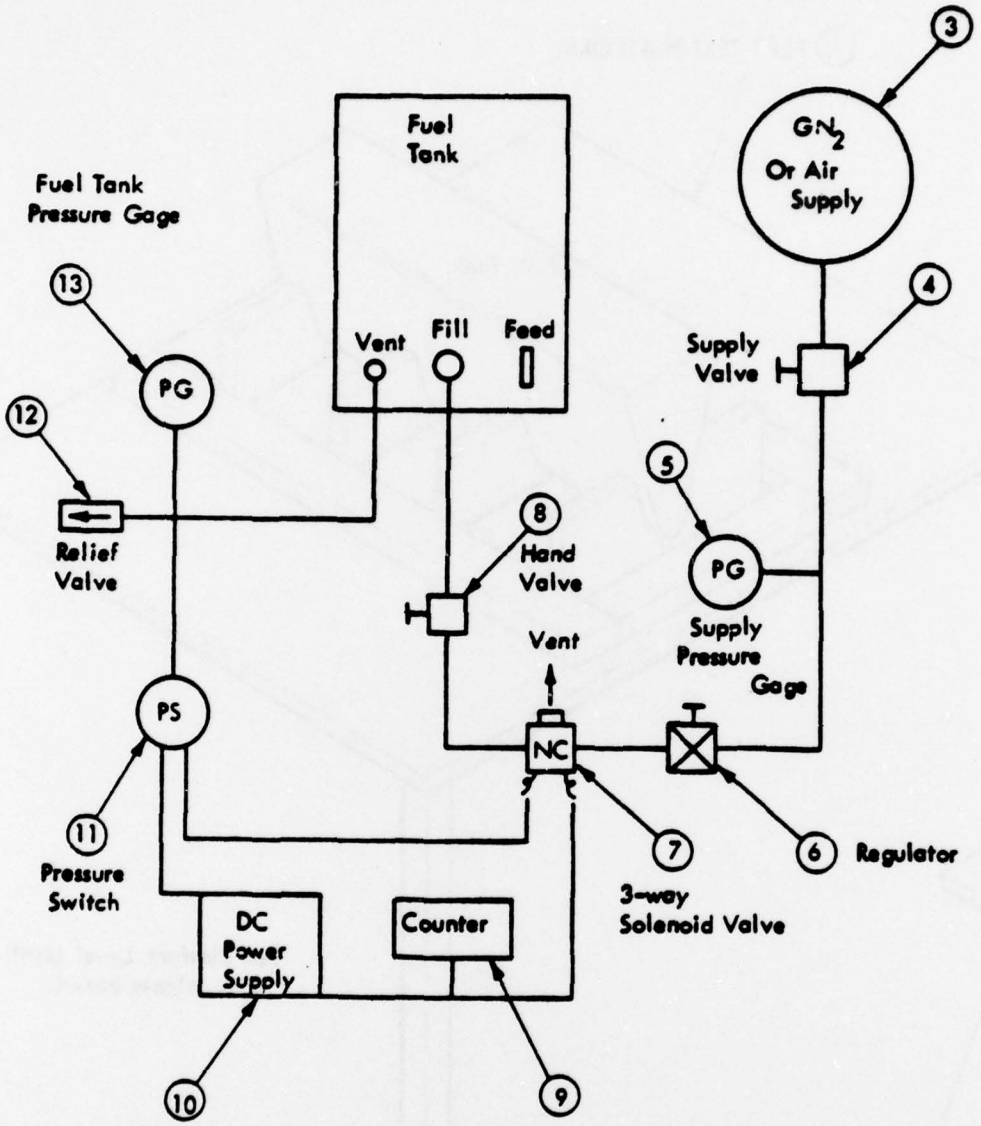


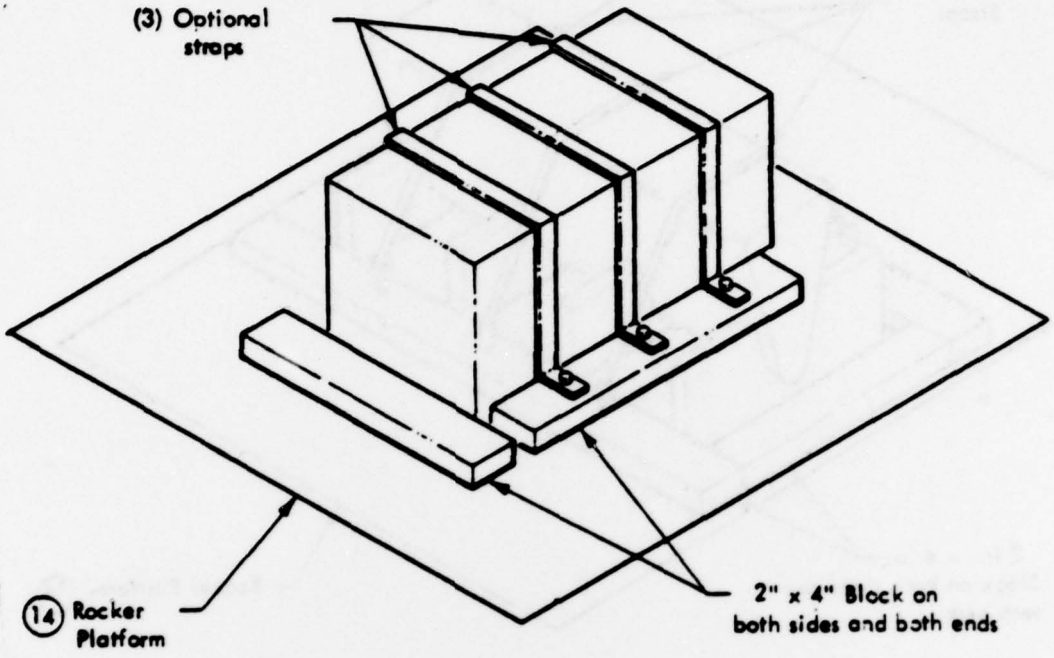
PRESSURE IMPULSE TEST — TYPICAL LAYOUT FOR NON-FLAT BOTTOMED TANK

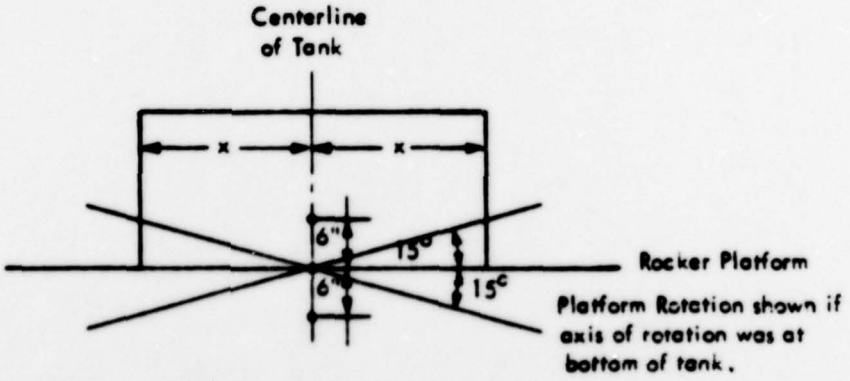
TEST SCHEMATIC PROCEDURE



PRESSURE IMPULSE TEST — TYPICAL SETUP

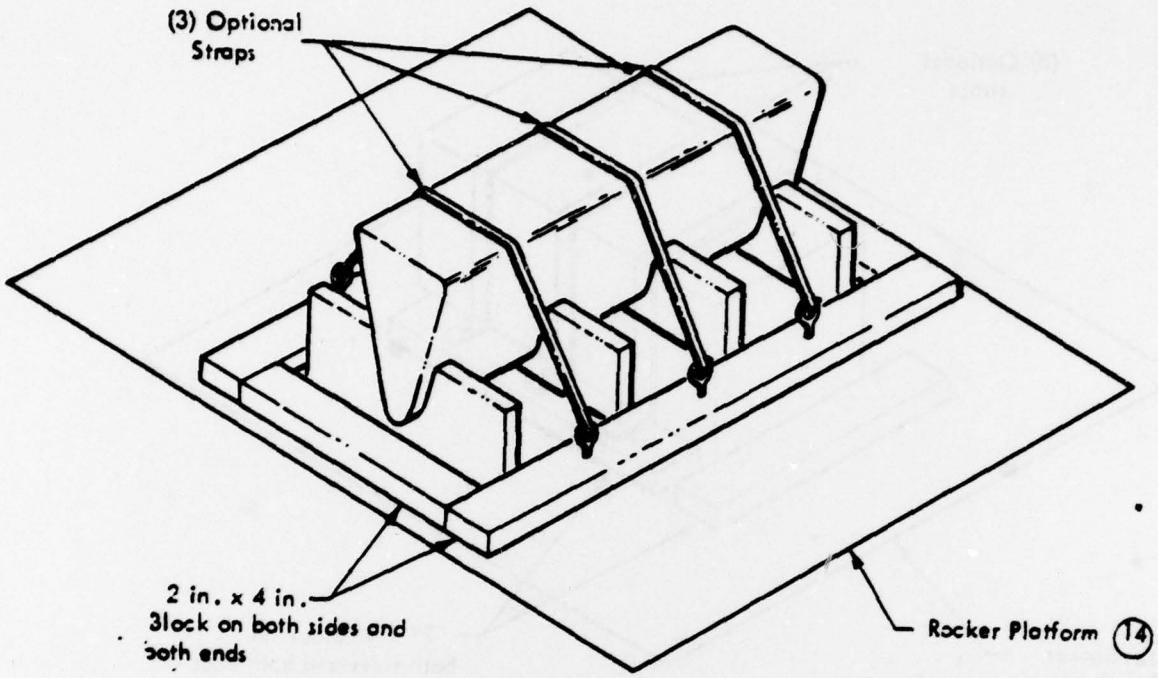
TEST SCHEMATIC PROCEDURE





SLOSH TEST – TYPICAL LAYOUT FOR FLAT BOTTOMED TANK

TEST SCHEMATIC PROCEDURE


(3) Optional
Straps
2 in. x 4 in.
Block on both sides and
both ends
Rocker Platform (14)

Component Find No.	Title	Description
7	3-Way, 2 Position NC Solenoid Valve	A solenoid valve used for cycling the pressure to the fuel tank. Controlled by Pressure Switch (see # 11).
8	Hand Valve	A hand operated shutoff valve used to isolate the fuel-tank from the pressure supply system.
9	Electronic Counter	A counter tied in electrically to the 3-way Solenoid Valve such that every time the valve cycles the counter registers. 25,000 capability.
10	DC Power Supply	A DC power supply for operating the 3-way Solenoid Valve and counter.
11	Pressure Switch	A 0-20 psig range with a 1.0 psig maximum deadband used for controlling the pressure cycles to the tank.
12	Relief Valve	A overpressure valve used for relieving excess pressure to the fuel tank in case a failure occurs in the supply system. Set at 4.25±0.25 psig.
13	Pressure Gauge	A gauge used for monitoring the pressure supplied to the fuel tank during each pressure pulse.
14	Rocker Platform	A flat level platform capable of having a fuel tank mounted on it and rocking ± 15° at a rate of 15 - 20 cycles per minute.

17.4 Test

17.4.1 This procedure shall be used to perform a pressure impulse test on fuel tanks which have a capacity of 25 gal. (94.6 l) or more. For fuel tanks which have been subjected to the pressure impulse test and have a capacity of 100 gal. (378.5 l) or more, an additional slosh test shall be performed as specified in this procedure. Verify the applicability of this procedure to the tank being tested before proceeding.

17.4.2 Visually inspect the fuel tank. Review the results of the Receiving Inspection and verify that the component is acceptable and ready for testing. Tanks that would obviously leak, have failed the pressure test or do not have a proper label, shall be rejected.

17.4.3 Verify that the fuel tank to be tested has successfully completed the static pressure test as specified in the pressure test. If it has not been accomplished, the pressure test shall be completed at this time. Record whether the pressure was previously accomplished or is being completed at this time

17.4.4 Non-metallic fuel tanks shall be filled to rated capacity as specified on the fuel tank label, with a gasoline that has at least a 50% aromatic content. ASTM Refernce Fuel C meets this requirement. The fuel tank shall bear no evidence that it has been adversely affected by the gasoline after 30 days at ambient temperature and pressure but in no case less than a temperature of 70°F (21°C).

Accomplish Paragraph 17.4.5

and terminate the test.

17.4.5 Flush and/or purge the fuel tank with water and/or GN_2 after the 30 day pre-conditioning test has been completed.

17.5 Pressure Impulse Test

17.5.1 Verify that the fuel tank has a capacity of 25 gal. (94.6 l) or more.

17.5.2 Mount and secure the fuel tank to a test platform similar to an actual installation or similar to one of the following installations. A flat bottomed tank shall be mounted on a flat platform. Tanks with other than flat bottoms shall be mounted on chocks cut to fit the tank contour, and located at the ends of the tank and at the tank baffles, if any. In any of the above installations, the platform at the end of the tank with the fill and vent fittings may be raised slightly to facilitate filling with water. Do not remove any attachments or fittingsfrom the tank. See the Test Schematic for a typical installation.

17.5.3 Fill the fuel tank with water to at least rated capacity. The fuller the tank is the faster the cycle rate will be. Cap or plug the tank fuel feed adapter. If a gasoline gauge is not installed, cap this opening. Connect a regulated source of air or GN_2 to the tank fill pipe. Connect a calibrated pressure gauge to the vent fill pipe to monitor the tank pressure. Connect a

pressure relief valve into the pressure gauge line. Adjust the relief pressure to 4.0 to 4.5 psig. Record the relief valve setting.

Also, connect a pressure switch control line into the pressure gauge line. The PS should have a range of no more than 0 - 20 psig with a 1.0 psig maximum deadband. The pressure supplied to the tank fill pipe shall be controlled and cycled by a 3-way, 2 position N.C. (vent position) solenoid valve. A counter capable of 25,000 cycles shall be tied into the solenoid valve to record the number of cycles completed. See the Test Schematic for the setup described above.

NOTE

This is a typical test setup to accomplish the pressure cycles required, but it is not the only acceptable setup for the test. Any equivalent combination of valving and arrangement of components can be used.

17.5.4 Vary the pressure in the fuel tank from zero psig to 3 - 3.4 psig at a rate not to exceed 15 cycles per minute. Zero psig shall be defined for the purposes of this test as 0.5 psig or less. The cycle rate will vary depending on the following conditions:

a. Supply pressure
b. Air volume in tank after water is added
c. Line sizes
d. Valve sizing, especially the vent port
e. The actual pressure settings used

Any of the above may be varied within reasonable limits to give the desired cycle rate up to the maximum of 15 cycles per minute. Record the upper and lower pressure settings and the cycle rate at the start of the test.

17.5.5 Apply 25,000 cycles of pressure to the fuel tank. Periodically (approximately once per hour) check the pressure and cycle conditions and adjust the system if required to stay within the requirements. The fuel tank shall not leak after the application of 25,000 cycles.

17.5.6 If the tank should start to leak prior to 25,000 cycles, the tank shall be rejected. Secure the test setup and do not accomplish the slosh test.

17.5.7 If the tank shows no indication of any leakage after 25,000 cycles, remove all the water from the tank and secure the system.

17.5.8 Perform the pressure test on the fuel tank and verify that the tank does not leak. If leakage is found during the pressure test, the tank shall be rejected.

Secure the test setup and do not accomplish the slosh test. If the fuel tank successfully completes the pressure test, the tank shall be deemed acceptable according to the requirements of this procedure for the Pressure Impulse Test.

Proceed to the Slosh Test.

17.6 Slosh Test

17.6.1 Verify that the fuel tank has a capacity of 100 gal. (378.5 l) or more. Verify that the pressure impulse test portion of this procedure has been completed successfully.

17.6.2 Mount and secure the fuel tank on a rocker platform similar to the installation used for the pressure impulse test. In addition, wood blocks should be mounted to the test platform at the forward and aft ends of the tank to prevent any longitudinal movement of the tank. Wood blocks should be mounted to the platform along the sides of the tank to prevent lateral movement. Straps or clips may be required to prevent vertical movement of the tank. See the Test Schematic for a typical installation.

17.6.3 Fill the tank with water to 50% of rated capacity.

17.6.4 Cap and/or plug the fuel tank fill pipe, the fuel tank vent pipe, and the fuel feed adapter. If a gasoline gauge is not installed, cap this opening.

17.6.5 Apply 500,000 cycles of rocking motion 15 degrees to each side of the tank centerline at a rate of 15 to 20 cycles per minute (one cycle equals 30 degrees of motion). The axis of rotation of the fuel tank shall be perpendicular to the centerline of the tank length at a level within six in. (15.2 cm) above or below the bottom of the tank. See the Test Schematic for a view of the rotation required. Record the cycles per minute and locate the axis of rotation.

17.6.6 If the fuel tank should start to leak prior to the completion of 500,000 cycles, the tank shall be rejected.

Secure the test setup and terminate the test.

17.6.7 If the tank shows no indication of any leakage after 500,000 cycles, remove all the water from the tank and secure the system.

17.6.8 Perform the pressure test on the fuel tank and verify that the tank did not leak. If leakage is found during the pressure test, the tank shall be rejected. If the fuel tank successfully passes the pressure test, the tank shall be deemed acceptable according to the requirements of this procedure for both the Pressure Impulse Test and the Slosh Test.

17.6.9 Secure the test setup.

18.0 LAB EXAMINATION NO. 14 -- FIRE TEST OF FUEL SYSTEM COMPONENTS

183.590 Fire Test

(a) A piece of equipment is tested under the following conditions and procedures:

(1) Fuel stop valves, "USCG Type A" hoses, clips, straps, and hose clamps are tested in a fire chamber.

(2) Fuel filters, strainers, and pumps are tested in a fire chamber or as installed on the engine.

(3) Fuel tanks must be tested filled with fuel to one-fourth the capacity marked on the tank in a fire chamber or in an actual or simulated hull section.

(b) Each fire test is conducted with free burning heptane and the component must be subjected to a flame for 2½ minutes.

(c) If the component is tested in a fire chamber—

(1) The temperature within one inch of the component must be at least 648°C sometime during the 2½ minute test;

(2) The surface of the heptane must be eight to 10 inches below the component being tested; and

(3) The heptane must be in a container that is large enough to permit the perimeter of the top surface of the heptane to extend beyond the vertical projection of the perimeter of the component being tested.

(d) If the component is being tested as installed on an engine, heptane sufficient to burn 2½ minutes must be poured over the component and allowed to run into a flat bottomed pan under the engine. The pan must be large enough to permit the perimeter of the top surface of the heptane to extend beyond the vertical projection of the perimeter of the engine.

(e) If a fuel tank is being tested in an actual or simulated hull section, the actual or simulated hull section must be of sufficient size to contain enough heptane to burn for 2½ minutes in a place adjacent to the tank.

NOTE

The requirements of this Lab Examination are prescribed by sections 183.510(b), 183.524(c), 183.526(a), 183.528(b), 183.532(b) and 183.534.

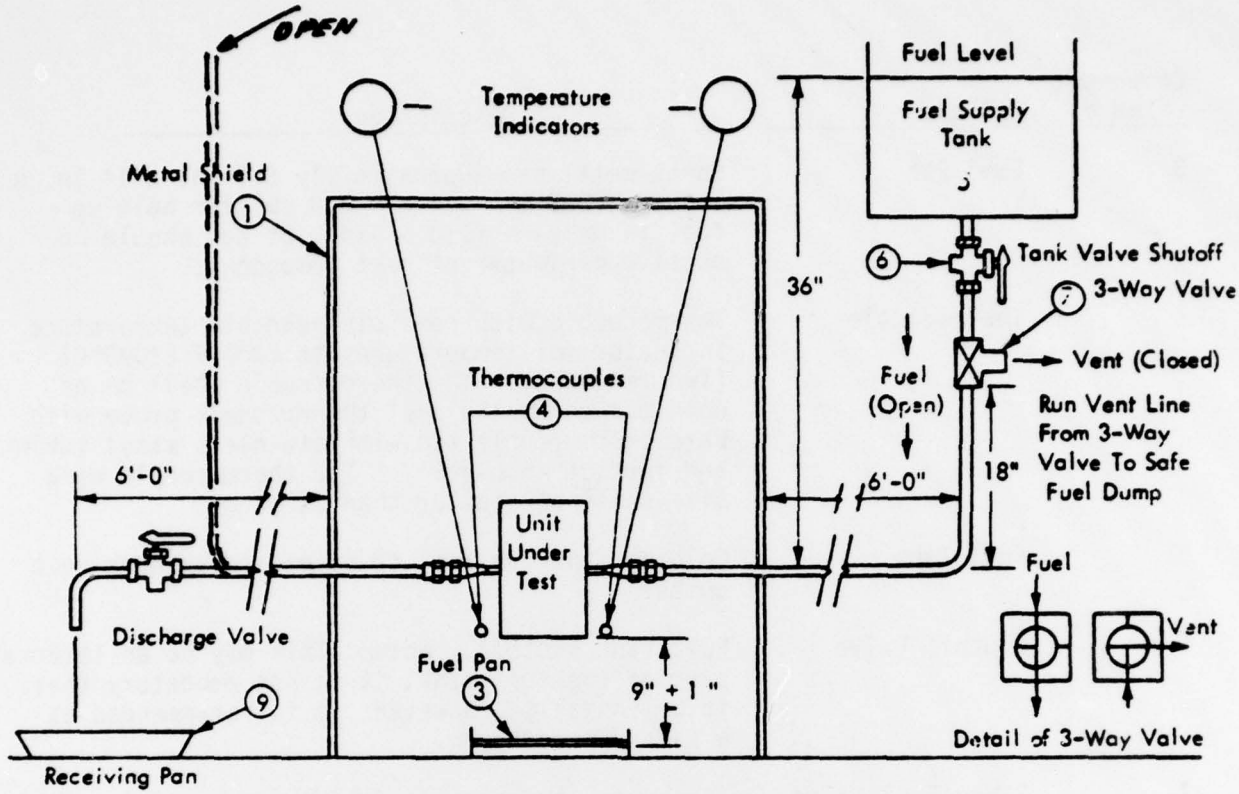
18.1 General Description - The fuel system component shall be mounted in a fire chamber as shown in the Test Schematic and subjected to a 2½ minute fire using heptane as the fuel. The component shall not leak any fuel during or after the test, except as allowed in §183.534. An entire fuel system or individual components may be tested in an installed configuration by this procedure if desired. In this case the component(s) would be mounted on an engine and subjected to a 2 1/2 minute fire.

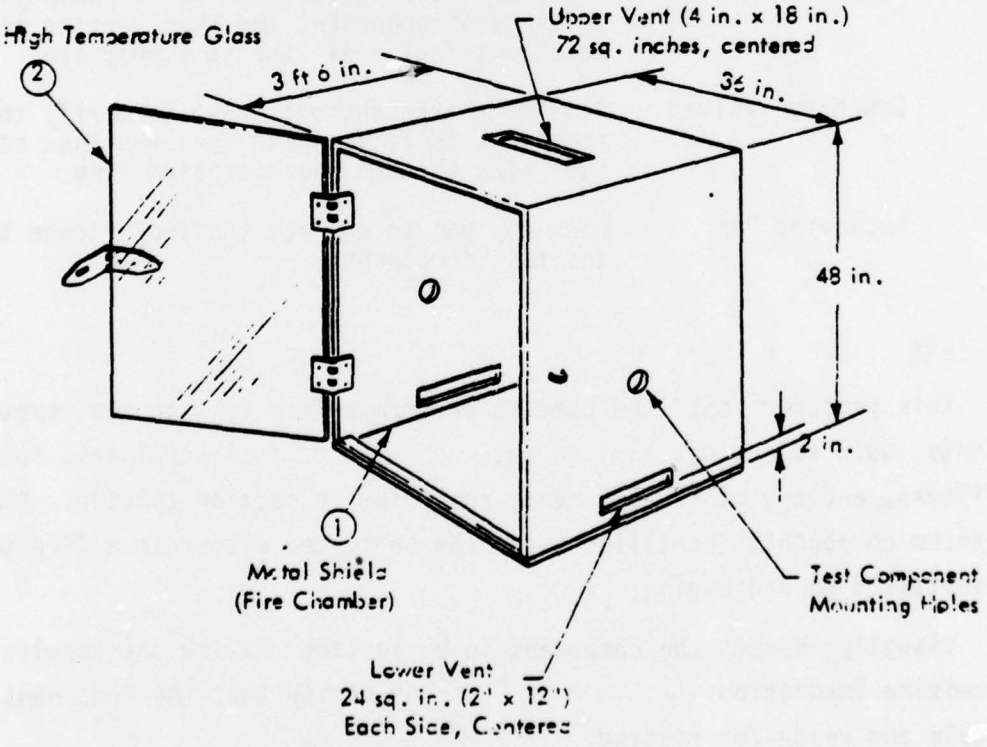
18.1.1 Test Article - The test article shall consist of either an individual fuel system component to be tested in a fire chamber, or a component(s) mounted on an engine similar to an actual installation. This procedure is applicable to fuel strainers, fuel filters, fuel pumps, Type A fuel hose and any other component not specified in the Test Procedures. Individual components tested in a fire chamber shall be installed similar to a typical installation in a boat.

18.1.2 Constraints - Components which have been qualified as individual components using the fire chamber are acceptable for use in any fuel system, however, components and/or systems which have been qualified while installed on an actual engine shall be acceptable for use only on that model engine on which they were tested.

18.2 Test Equipment and Material

Component Find No.	Title	Description
1	Metal Shield (Fire Chamber)	16 gauge sheet metal housing 36 in. x 48 in. x 42 in. (0.9 m x 1.2 m x 1.2 m) with one end open. This protects the test unit from the environmental elements.
2	Test Viewing Cover	High temperature glass approximately 42 in. x 54 in. x 0.25 in. (1.1 m x 1.4 m x 0.6cm) used as fourth side of metal shield. Should be capable of completely sealing off this side and withstanding approximately 1600°F (871°C).





TEST SCHEMATIC PROCEDURE

Component Find No.	Title	Description
3	Fuel Pan	Sheet metal pan approximately 8.5 in. x 14 in. x 1.5 in. (0.2 m x 0.4 m x 3.8 cm) for holding fuel in metal shield. Sides of pan should be outside perimeter of test component.
4	Thermocouple	Thermocouple with remotely readable temperature indicator for temperatures to 2000°F (1093°C) (Two required). The thermocouple shall be an open tip chromel-alumel thermocouple probe with bare thermocouple tip with stainless steel tubing and formica insulation. The thermocouple wire size shall be smaller than 22 gauge.
5	Fuel Tank	Holding tank for fuel to be passed through test units.
6	Shutoff Valve	Fuel tank shutoff. Note: This may be an integral part of the fuel tank, it is not mandatory that it be installed, however, it is recommended as a safety precaution.
7	3-Way Fuel Valve	Three-way, two-position valve for supplying fuel to the test component and then venting test component fuel fill line to atmosphere.
8	Discharge Valve	Fuel discharge shutoff valve to verify the test component is filled with fuel and then stop fuel flow through the discharge line.
9	Receiving Pan	Open top pan to collect the fuel flowed through the test component.

18.3 Test

18.3.1 This procedure shall be used to perform a fire test on fuel system components, such as but not limited to, fuel strainers, fuel pumps, fuel filters, and any other components specified in section 183.590. The three fuel system components identified above may be tested either in a fire chamber or as installed on the engine.

18.3.2 Visually inspect the component to be tested. Review the results of the Receiving Inspection and verify that the component is acceptable and ready for testing.

18.3.3 Verify the applicability of this procedure to the component being tested before proceeding.

18.3.4 Fire Chamber Test

18.3.4.1 Mount and secure the component in a fire chamber as shown in the Test Schematic, Paragraph 18.2, and similar to a typical boat installation. Connect an inlet and outlet copper line to the component.

18.3.4.2 Connect the other end of the inlet line to a 3-way, 2-position valve and fuel supply tank as shown in the Test Schematic.

NOTE

Although a 3-way valve has been shown in the Test Schematic, any equivalent combination of valves may be used to accomplish the same result.

18.3.4.3 Connect the outlet line to a shutoff valve over a receiving tank as shown in the Test Schematic (not applicable to carburetors).

18.3.4.4 Position an 8½ in. x 14 in. x 1½ in. (21.6 cm x 35.6 cm x 3.8 cm) (approximate) fuel pan directly under the test component. The bottom of the test component shall be 9±1 in. (22.9±2.5 cm) above the liquid surface of the fuel. The perimeter of the fuel pan shall extend beyond the vertical projection of the perimeter of the component being tested.

18.3.4.5 Two thermocouples shall be positioned even with the lowest point of the test component, one on each side, within one inch (2.5 cm) of the component, as shown in the Test Schematic. The thermocouple shall be capable of measuring 1200°F (648°C) at a remote station.

18.3.4.6 With all control valves in the closed position, fill the fuel supply tank with a quantity of pump gasoline (regular) sufficient to fill the test system (approximately 2 or 3 gal, (7.6 or 11.4 l)). Closed position for the 3-way valve is in the vent position.

18.3.4.7 Open the tank shutoff valve, the 3-way valve, and the discharge shutoff valve and allow a sufficient amount of gasoline to flow through the test setup to insure the system has been bled of all air and that the test component is filled with gasoline. Some components may have to be electrically or mechanically

operated momentarily to accomplish this.

18.3.4.8 With the system full of gasoline close the discharge shutoff valve and perform a visual leak check of the system. There shall be no leakage of gasoline. Then close (vent position) the 3-way supply valve. In this position the fuel supply tank is isolated and the test component is vented to the atmosphere.

18.3.4.9 Remove the fuel pan from the fire chamber and fill it with technical grade of better heptane to a depth sufficient to burn for at least 2½ min. (approximately ½ in. (1.3 cm)). Carefully replace the fuel pan (no spillage allowed) back into the fire chamber in the proper position. Measure the height from the bottom of the test component to the liquid surface

This height shall be 9±1 in. (22.9±2.5 cm).

18.3.4.10 Verify that the system is ready for the test and that all safety precautions are in effect. A CO_2 fire extinguisher or equivalent should be ready.

18.3.4.11 Place the Pyrex glass shield into position and secure it.

18.3.4.12 With all personnel at a safe distance from the fire chamber, ignite the heptane in the fuel pan through one of the vent holes using a three foot (0.9 m) torch and allow it to burn for 2½ min. It is desirable to continually record the temperatures encountered during the burn period, however, in no case should the recording interval exceed five seconds. During the 2½ min., one temperature indication of at least 1200°F (648°C) shall be required at one of the two positions. Record the highest temperature observed during the test

Visually monitor the test system during the burn period for any indication of gasoline leakage. No leakage is allowed.

NOTE

Even though leakage is observed during this part of the test, the rest of the test shall be accomplished to verify the actual point of leakage is in the component and not part of the test setup.

18.3.4.13 After 2½ min. of burn time, extinguish the fire with CO_2 or other suitable means. Do not disturb the test component or discharge the CO_2 directly

on the component.

18.3.4.14 Immediately after the fire has been extinguished, open the discharge shutoff valve and then the 3-way supply valve. Gasoline may not flow from the discharge part immediately, depending on the component being tested, the temperature and the degradation resulting from the fire. Close the discharge shutoff valve after there is a steady flow of gasoline. Leave the 3-way supply valve open and verify that the level of gasoline in the fuel supply tank is 36±1 in. (91±2.5 cm) above the inlet line to the fire chamber. Add pump gasoline (regular) as necessary.

18.3.4.15 Perform a visual check of the test component and the inlet fittings. There shall be no leakage of gasoline. If any indication of leakage is observed, the test component shall be rejected.

If no leakage is observed, the test component shall be deemed acceptable according to the requirements of this procedure.

NOTE

A leakage of 5 oz. in 2½ minutes is allowed from the fuel pump, filter, strainer and fuel line combined.

18.3.4.16 Secure the test system as required and safe the area.

18.3.5 Installed Test

18.3.5.1 Fuel pumps, fuel filters and fuel strainers may be tested as installed on the engine, either singularly or all at the same time.

18.3.5.2 Position the engine in a level position in a container. The container shall be large enough to permit the perimeter of the top surface of the heptane to extend beyond the vertical projection of the perimeter of the engine.

18.3.5.3 Verify that the component (or components) to be tested is full of

gasoline. The system may have to be operated momentarily to accomplish this

18.3.5.4 Remove, de-energize or disconnect all potential sources of ignition (fuel and electrical).

CAUTION

Verify that all safety requirements are in effect before proceeding.

18.3.5.5 Pour a quantity of heptane sufficient to burn for 2½ min. over the components to be tested with the excess being caught in the container under the engine. In addition, the quantity shall be sufficient to cover the entire bottom area of the container for the entire test. To meet this requirement, the container bottom should be as flat and level as possible.

18.3.5.6 The heptane shall be ignited at all locations and allowed to burn for 2½ minutes. Visually monitor the test system during the burn period for any indication of gasoline leakage. No leakage is allowed.

Extinguish the fire with CO_2 or other suitable means. There is no minimum temperature requirement for this test.

18.3.5.7 Perform a visual leak check of the test component(s) as soon as the fire has been extinguished. There shall be no leakage of gasoline. If any indication of leakage is observed, the test component shall be rejected.

If no leakage is observed, check for leak in accordance with Paragraph 18.3.4.14.

18.3.5.8 Secure the test system as required and safe the area.

VISUAL EXAMINATIONS

19.0 FIELD/VISUAL EXAMINATION NO. 1 -- PROHIBITED TANK MATERIAL

183.512 Fuel tanks: prohibited materials

(a) A fuel tank must not be constructd from terneplate.

(b) Unless it has an inorganic sacrificial galvanic coating on the inside and outside of the tank, a fuel tank must not be constructed from black iron or carbon steel.

(c) A fuel tank encased in cellular plastic or in fiber reinforced plastic must not be constructed from a ferrous alloy.

19.1 The correct tank material should be shown on the tank label in accordance with the requirements of section 183.514.

19.1.1 If this information is not present, the tank is not in compliance.

19.1.2 The identification of some tanks made of copper, galvanized steel, stainless steel, aluminum and reinforced fiberglass may be obvious by visual inspection.

19.2 Apparatus - Magnet, knife, alkaline cleaner, emulsion or solvent cleaner, isopropyl alcohol, silver nitrate $AgNO_3$ solution (200 g dissolved in distilled water and diluted to one liter with distilled water).

19.3 Test Specimens - The fuel tank(s) as received in the boat.

19.4 Test Procedure

19.4.1 Tanks with unknown materials will be tested as follows:

19.4.2 Determine whether the material of construction of the tank is ferrous by determining whether the material is attracted to a magnet. If not, no further testing of the material is required.

19.4.3 If the material is attracted to a magnet, then prepare the area of the tank's surface to be tested. An area of at least 2 sq. in. is required.

19.4.3.1 Grease, oil, lubricants and paints or coatings shall be removed by alkaline cleaners, emulsion or solvent cleaners or other suitable means prior to applying the reagent solution. Care must be taken to assure that the plating itself is not removed by abrasion or chemical reactions with the cleaners.

19.4.3.2 The specimen surface area shall be cleaned by washing with solvent naptha or another suitable solvent, then with alcohol and then dried thoroughly.

19.4.3.3 Remove a few scrapings from the cleaned surface. Care must be taken so that the coating on the material, if any, is not completely scraped through and into the base material. Determine whether the scrapings are attracted to a magnet. If so, the material is not considered acceptable.

19.4.4 If the scrapings are not attracted to a magnet, then determine whether the coating is a lead-tin alloy.

19.4.4.1 The specimen surface area shall be held approximately level so that the drops of the reagent will not flow. NOTE: Use caution when handling silver nitrate since it is a poisonous irritant.

19.4.4.2 Place three or four drops of the silver nitrate solution on the prepared surface and allow it to stand for three minutes. At the end of three minutes, flush the surface with water, but do not wipe the surface. The presence of a lead-tin alloy is indicated by dark spotting on the surface where silver nitrate came into contact with it.

19.5 If there is no spotting, then the coating is considered acceptable and, therefore the material of construction is considered acceptable.

20.0 FIELD/VISUAL EXAMINATION NO. 2 -- LABEL ON TANK

183.514 Fuel tanks: labels

(a) Each fuel tank must have a label that meets the requirements of paragraphs (b) through (d) of this section.

(b) Each label required by paragraph (a) of this section must contain the following information:

(1) Fuel tank manufacturer's name (or logo) and address.

(2) Month (or lot number) and year of manufacture.

(3) Capacity in U.S. gallons.

(4) Material of construction.

(5) The pressure the tank is designed to withstand without leaking.

(6) Model number, if applicable.

(7) The statement, "This tank has been tested under 33 CFR 183.580."

(8) If the tank is tested under § 183.584 at less than 25g vertical accelerations the statement, "Must be installed aft of the boat's half length."

(c) Each letter and each number on a label must—

(1) Be at least $\frac{1}{4}$ inch high and

(2) Contrast with the basic color of the label or be embossed on the label.

(d) Each label must—

(1) Withstand the combined effects of exposure to water, oil, salt spray, direct sun light, heat, cold, and wear expected in normal operation of the boat, without loss of legibility; and

(2) Resist efforts to remove or alter the information on the label without leaving some obvious sign of such efforts.

20.1 Test - Self Explanatory

21.0 FIELD/VISUAL EXAMINATION NO. 3 -- TANK OPENINGS

183.518 Fuel tank opening

Each opening into the fuel tank must be at or above the topmost surface of the tank.

21.1 Test - Self Explanatory

NOTE

A spud welded to the side of the tank is acceptable as long as the top opening of the spud is above the top of the tank.

22.0 FIELD/VISUAL EXAMINATION NO. 4 -- ELECTRIC FUEL PUMP

183.524(b) Fuel pumps

(b) Each electrically operated fuel pump must not operate except when the engine is operating or when the engine is started.

22.1 Test - See Lab Examination No. 4 (Paragraph 8.0)

23.0 FIELD/VISUAL EXAMINATION NO. 5 -- FUEL STOP VALVE

183.528(a) Fuel stop valves

(a) Each electrically operated fuel stop valve in a fuel line between the fuel tank and the engine must—
(1) Open electrically only when the ignition switch is on; and
(2) Operate manually.

23.1 Test - See Lab Examination No. 6 (Paragraph 10.0)

24.0 FIELD/VISUAL EXAMINATION NO. 6 -- HOSE INSTALLATION ON SPUDS

183.530 Spud, pipe and hose fitting configuration

Except when used for a tank fill line, each spud, pipe, or hose fitting used with hose clamps must have—
(a) A bead;
(b) A flare; or
(c) A series of annular grooves or serrations no less than 0.015 inches deep, except a continuous helical thread, knurl, or groove.

24.1 Test - Self Explanatory

25.0 FIELD/VISUAL EXAMINATION NO. 7 -- CLIPS, STRAPS - WIDTH, CORROSION

183.532 Clips, straps, and hose clamps

(a) Each clip, strap, and hose clamp must—
(1) Be made from a corrosion resistant material; and
(2) Not cut or abrade the fuel line.
(b) When tested under § 183.590, a clip, strap, or hose clamp must not separate under a one pound tensile force.
(c) The minimum nominal band width of a hose clamp is determined under Table 7 by the outside diameter of the hose.

25.1 Test

TABLE 7

Outside hose diameter (inches)	Minimum nominal clamp band width (inches)
Less than 7/16	1/4
7/16 to 13/16	5/16
Greater than 13/16	1/2

NOTE

Clips, straps and hose clamps cannot be made of untreated carbon steel Suitable materials are stainless steel, galvanically plated steel, plastic sealed steel, non-ferrous metals and plastics.

26.0 FIELD/VISUAL EXAMINATION NO. 8 -- SEALS AND GASKETS

183.536(a) Seals and gaskets in fuel filters and strainers

(a) Each gasket and seal used in a fuel filter and strainer must form an unsplit ring.

26.1 Test - See Lab Examination No. 7 (Paragraph 11.0)

27.0 FIELD/VISUAL EXAMINATION NO. 9 -- FUEL LINE MATERIAL

183.538 Metallic fuel line materials

> Each metallic fuel line connecting the fuel tank with the fuel inlet connection on the engine must—
> (a) be made of seamless annealed copper, nickel copper, or copper-nickel; and
> (b) except for corrugated flexible fuel line, have a minimum wall thickness of 0.029 inches.

27.1 Test

27.1.1 The fuel tank vent lines and fuel distribution lines are inspected by Visual Examinations if any doubt exists as to the line material.

27.2 Apparatus - Fume hood vented to the atmosphere and a beaker of nitric acid, HNO_3 (200 ml).

27.3 Test Specimens - One inch long segments of the metal fuel vent and distribution lines as installed in the boat.

27.4 Test Conditions - Observe all necessary safety precautions, particularly relative to adequate ventilation.

27.5 Procedure

27.5.1 Copper can usually be identified by its reddish-brown color.

27.5.1.1 If in doubt, place a magnet on the line. It should not be attracted by the copper line.

27.5.1.2 If it is attracted, it may be a copper plated steel line. This can also be confirmed by filing the surface to expose the material.

27.5.1.3 If it is not attracted by a magnet, it may be copper plated non-ferrous metal.

27.5.2 Nickel-copper and copper-nickel are not attracted by a magnet.

27.5.3 Most types of stainless steel are not attracted by a magnet.

27.5.4 Aluminum is not attracted by a magnet.

27.5.5 As a proof test, cut out a one inch section of the line in question to be used as a specimen.

27.5.5.1 Place the specimen in a solution of 200 ml of nitric acid mixed with 10 ml of water.

CAUTION

The beaker of nitric acid must be placed in a fume hood to avoid breathing the fumes.

27.5.5.2 If the material is nickel-copper or copper-nickel, the solution of nitric acid and water will turn a blue-green color and will give off brownish color fumes. If the material is copper, the solution will tuen to a blue color. This will take place within 30 seconds.

27.5.5.2.1 The solution will show evidence of eating away at the specimen within one minute and will show definite damage within 15 minutes.

27.5.5.3 If the specimen is stainless steel, plated steel or aluminum, it will not be affected by the solution nor will the solution change color.

28.0 FIELD/VISUAL EXAMINATION NO. 10 -- HOSE-- IDENTIFICATION

183.540 Hoses: identification

(a) Each "USCG Type A" hose and each "USCG Type B" hose must be identified by the manufacturer by a marking on the hose itself. If the complete text of the marking is not on a section of hose, the boat manufacturer must attach a tag that meets the requirements of paragraphs (b) and (c) of this section.

(b) Each marking and tag must contain the following information in English:

(1) The statement "USCG TYPE (insert A or B) HOSE."

(2) The year in which the hose was manufactured.

(3) The manufacturer's name or registered trademark.

(c) Each character must be block capital letters and numerals that are at least one-eighth inch high.

(d) Each marking must be permanent, legible, and on the outside of the hose at intervals of 12 inches or less.

28.1 Test - Self Explanatory

29.0 FIELD/VISUAL EXAMINATION NO. 11 -- TANK INSTALLATION

183.550 Fuel tanks: installation

(a) Each fuel tank must not be integral with any boat structure or mounted on an engine.

(b) Each fuel tank must not move at the mounting surface more than one-fourth inch in any direction.

(c) Each fuel tank must not support a deck, bulkhead, or other structural component.

(d) Water must drain from the surface of each metallic fuel tank when the boat is in its static floating position.

(e) Each fuel tank support, chock, or strap that is not integral with a metallic fuel tank must be insulated from the tank surface by a nonmoisture absorbing material.

(f) Cellular plastic must not be the sole support for a metallic fuel tank.

(g) If cellular plastic is the sole support of a non-metallic fuel tank, the cellular plastic must meet the requirements of § 183.516 (b) or (c)

(h) Each fuel tank labeled under § 183.514(b)(8) for installation aft of the boat's half length must be installed with its center of gravity aft of the boat's half length.

29.1 Test - See Lab Examination No. 8 (Paragraph 12.0)

30.0 FIELD/VISUAL EXAMINATION NO. 12 -- ACCESSIBILITY OF ENCASED TANK FITTINGS

183.554 Fittings, joints and connections

Each fuel system fitting, joint, and connection must be arranged so that it can be reached for inspection, removal, or maintenance without removal of permanent boat structure.

30.1 Test

30.2 Access to fittings, joints and connections has to be gained by using normal hand tools. Glassed in panels or glued in carpets do not provide accessibility. A floor hatch which is screwed in place is acceptable even if a sealant has been used in the seam between the hatch and the floor.

31.0 FIELD/VISUAL EXAMINATION NO. 13 -- DRAIN PLUGS IN FUEL SYSTEM

183.556 Plugs and fittings

(a) A fuel system must not have a fitting for draining fuel.
(b) A plug used to service the fuel filter or strainer must have a tapered pipe-thread or be a screw type fitted with a locking device other than a split lock washer.

31.1 Test - Self Explanatory

32.0 FIELD/VISUAL EXAMINATION NO. 14 -- HOSES (A or B) AND CONNECTIONS

183.558

(a) Each hose between the fuel pump and the carburetor must be "USCG Type A" hose.
(b) Each hose used for a vent line or fill line and each hose from the fuel tank to the fuel inlet connection on the engine must be—
(1) "USCG Type A" hose; or
(2) "USCG Type A" or "USCG Type B" hose, if no more than five ounces of fuel is discharged in 2½ minutes when—
(i) The hose is severed at the point where maximum drainage of fuel would occur,
(ii) The boat is in its static floating position, and
(iii) The fuel system is filled to the capacity marked on the tank label under § 183.514(b)(5).
(c) Each hose must be secured by—
(1) A swaged sleeve;
(2) A sleeve and threaded insert; or
(3) A hose clamp.
(d) The inside diameter of a hose must not exceed the actual minor outside diameter of the connecting spud, pipe, or fitting by more than the distance shown in Table 8.

TABLE 8

If minor outside diameter of the connecting spud, pipe, or fitting is—	The inside diameter of the hose must not exceed the minor outside diameter of the connecting spud, pipe, or hose fitting by more than the following distance:
Less than ⅜ in...	0.020 in.
⅜ in. to 1 in.....	0.035 in.
Greater than 1 in..	0.065 in.

32.1 Test - Self Explanatory

NOTE

The discharge is measured by cutting the fuel hose and supporting the cut ends at their original position.

33.0 FIELD/VISUAL EXAMINATION NO. 15 -- CLAMPS - INSTALLATION

183.560 Hose clamps: installation

Each hose clamp on a hose from the fuel tank to the fuel inlet connection on the engine, a hose between the fuel pump and the carburetor, or a vent line must—

(a) Be used with hose designed for clamps;

(b) Be at least one clamp width from the hose end;

(c) Be beyond the bead, flare, or over the serrations of the mating spud, pipe, or hose fitting; and

(d) Not depend solely on the spring tension of the clamp for compressive force.

33.1 Test - Self Explanatory

34.0 FIELD/VISUAL EXAMINATION NO. 16 -- METALLIC FUEL LINE TO ENGINE

183.562 Metallic fuel lines

(a) Each metallic fuel line that is mounted to the boat structure must be connected to the engine by a flexible fuel line.

(b) Each metallic fuel line must be attached to the boat's structure within four inches of its connection to a flexible fuel line.

34.1 Test - Self Explanatory

NOTE

A solid line forming a loop is not considered flexible.

35.0 FIELD/VISUAL EXAMINATION NO. 17 -- FILL HOSE CONNECTION

183.564 Fuel tank fill system

(a) Each fuel fill opening must be located so that a gasoline overflow of up to five gallons per minute for at least five seconds will not enter the boat when the boat is in its static floating position.

(b) Each hose in the tank fill system must be secured to a pipe, spud, or hose fitting by—

(1) A swaged sleeve;

(2) A sleeve and threaded insert; or

(3) Two adjacent metallic hose clamps that do not depend solely on the spring tension of the clamps for compressive force.

(c) Each hose clamp in the tank fill system must be used with a hose designed for clamps.

(d) Hose clamps used in the tank fill system must—

(1) Have a minimum nominal band width of at least one-half inch; and

(2) Be over the hose and the spud, pipe, or hose fitting and not less than one-half inch from the end of the hose.

35.1 Test - See Lab Examination No. 3 (Paragraph 7.0)

36.0 FIELD/VISUAL EXAMINATION NO. 18 -- FUEL PUMP - LOCATION

183.566 Fuel pumps: placement

Each fuel pump must be on the engine it serves or within 12 inches of the engine, unless it is a fuel pump used to transfer fuel between tanks.

36.1 Test - Measure 12 inches in a straight line between the pump and any part of the engine or an accessory that comes with the engine.

37.0 FIELD/VISUAL EXAMINATION NO. 19 -- ANTI-SIPHON PROTECTION

183.568 Anti-siphon protection

Each fuel line from the fuel tank to the fuel inlet connection on the carburetor must—

(a) Be above the level of the tank top; or

(b) Have an anti-siphon device or an electrically operated fuel stop valve—

(i) at the tank withdrawal fitting; or

(ii) installed so the line from the fuel tank is above the top of the tank.

37.1 Test

37.1.1 Determine by visual inspection whether there is an anti-siphon valve or an electrically operated stop valve at the feed connection of the fuel tank or whether all parts of the feed lines or the line between the tank and valve are above the fuel tank top.

37.2 This test will determine whether the anti-siphon valve closes when there is no fuel pump suction and when there is a break in the fuel distribution line.

37.3 Determine where a hole in the line would siphon out the maximum amount of fuel from the fuel tank if siphoning could occur.

37.4 Apparatus - The fuel system as installed in the boat.

37.5 Test Specimen - The anti-siphon valve as installed in the boat.

37.6 Test Conditions - Boat to be in normal static floating position (see Paragraph 7.1.4) and not located in an enclosure.

37.7 Procedure

37.7.1 Fill the fuel feed line from the tank to the carburetor with fuel.

37.7.2 Fill the tank to the top of the vent spud of the tank.

37.7.3 Disconnect or sever the fuel feed line at its "worst case" location (see Paragraph 37.3).

37.7.4 Contain and measure the amount of all fuel that runs out of the break in the line.

37.7.4.1 The only acceptable fuel flow allowance is that amount equal to that contained in the line downstream from the anti-siphon valve.

38.0 FIELD/VISUAL EXAMINATION NO. 20 -- FUEL FILTER - INDEPENDENT SUPPORT

183.570 Fuel filters and strainers: installation

Each fuel filter and strainer must be supported on the engine or boat structure independent from its fuel line connections, unless the fuel filter or strainer is inside a fuel tank.

38.1 Test - Self Explanatory

39.0 FIELD/VISUAL EXAMINATION NO. 21 -- GROUNDING - TANK FILL

183.572 Grounding

Each metallic component of the fuel fill system and fuel tank which is in contact with fuel must be statically grounded so that the resistance between the ground and each metallic component of the fuel fill system and fuel tank is less than 100 ohms.

39.1 Test - Self Explanatory

federal register

MONDAY, JANUARY 31, 1977

PART XI

DEPARTMENT OF TRANSPORTATION

Coast Guard

■

BOATS AND ASSOCIATED EQUIPMENT

Safety Standards for Gasoline Fuel Systems

§ 183.516 [Amended]

3. Section 183.516 is amended by adding the word "metallic" before the words "fuel tanks" in the second line of paragraph (b) and in the second line of paragraph (c).

§ 183.520 [Amended]

4. Section 183.520 is amended by adding the word "vent" before the word "systems" in the section title.

5. By revising § 183.524(c) to read as follows:

§ 183.524 Fuel pumps.

• • • • •

(c) If tested under § 183.590, each fuel pump, as installed in the boat, must not leak more than five ounces of fuel in 2½ minutes, inclusive of leaks from fuel line, fuel filter and strainer.

§ 183.526 [Amended]

6. By deleting §183.526(a).

§ 183.532 [Amended]

7. By revising Table 7 of § 183.532 to read as follows:

• • • • •

TABLE 7

Outside hose diameter (inches):	*Minimum nominal clamp band width (inches)*
Less than 7/16	1/4
7/16 to 13/16	5/16
Greater than 13/16	1/2

8. By revising § 183.534 to read as follows:

§ 183.534 Fuel filters and strainers.

If tested under § 183.590, each fuel filter and strainer, as installed in the boat, must not leak more than five ounces of fuel in 2½ minutes inclusive of leaks from the fuel pump and fuel line.

§ 183.582 [Amended]

9. In § 183.582(a) by striking the word "carburetor" in the third line and inserting the words "engine fuel inlet" in place thereof.

10. By revising § 183.590(a)(2) to read as follows:

§ 183.590 Fire test.

(a) • • •

(2) Fuel filters, strainers and pumps are tested in a fire chamber or as installed on the engine in the boat.

§§ 183.501 [Amended]

In § 183.501, paragraph (b) is revised to read as follows:

• • • • •

(b) • • •

AUGUST 1, 1978

183.512	183.540
183.516	183.552
183.524 (a) and (b)	183.558

FEBRUARY 1, 1979

183.524(c)	183.526

Subpart J—Fuel Systems

GENERAL

AUTHORITY: 46 U.S.C. 1454; 49 CFR 1.46 (n)(1).

Subpart J—Fuel Systems

GENERAL

§ 183.501 Applicability.

(a) This subpart applies to all boats that have gasoline engines, except outboard engines, for electrical generation or mechanical power for propulsion.

(b) The sections in this subpart are effective on the following dates:

AUGUST 1, 1977

183.501	183.562
183.505	183.566
183.507	183.568
183.518	183.572
183.520	183.580
183.528	183.582
183.534	183.584
183.536	183.586
183.538	183.588
183.542	183.590
183.556	

FEBRUARY 1, 1978

183.510	183.550
183.514	183.554
183.522	183.560
183.530	183.564
183.532	183.570

AUGUST 1, 1978

183.512	183.540
183.516	183.552
183.524	183.558
183.526	

§ 183.505 Definitions.

As used in this subpart—

"ASTM" means American Society for Testing and Materials. ASTM standards in this subpart may be examined at Coast Guard Headquarters, Room 4314, Trans Point Building, 2100 2nd St., S.W., Washington, D.C. 20590 and may be obtained from the American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.

"Flame arrestor" means a device or assembly that prevents passage of flame through a fuel vent.

"Fuel system" means the entire assembly of the fuel fill, vent, tank, and distribution components, including pumps, valves, strainers, carburetors, and filters.

"Military Specification" means a specification developed by the U.S. Armed Forces. Military Specifications in this subpart may be examined at Coast Guard Headquarters, room 4314, Trans Point Building, 2100 2nd St., S.W. Washington, D.C. 20590 and may be obtained from the Commander, Naval Ship Engineering Center, DOD Standardization Program & Documents Branch, Hyattsville, Maryland 20782.

"SAE" means Society of Automotive Engineers, Inc. SAE standards in this subpart may be examined at Coast Guard Headquarters, Room 4314, Trans Point Building, 2100 2nd St., S.W., Washington, D.C. 20590 and may be obtained from the Society of Automotive Engineers, Inc., 400 Commonwealth Dr., Warrendale, PA 15096.

"Static floating position" means the attitude in which a boat floats in calm water, with each fuel tank filled to its rated capacity, but with no person or item of portable equipment on board.

"UL" means Underwriters' Laboratories, Inc. UL standards in this subpart may be examined at Coast Guard Headquarters, Room 4314, Trans Point Building, 2100 2nd St., S.W., Washington, D.C. 20590 and may be obtained from Underwriters' Laboratories, Inc., 207 East Ohio Street, Chicago, IL. 60611.

"USCG Type A Hose" means hose that meets the performance requirements of—

(1) SAE Standard J30C, dated March, 1976 and the requirements of § 183.590; or

(2) UL Standard 1114 dated September 15, 1976.

"USCG Type B Hose" means hose that meets the performance requirements of SAE Standard J30C, dated March, 1976.

§ 183.507 General.

Each fuel system component on a boat to which this subpart applies must meet the requirements of this subpart unless the component is part of an outboard engine or is part of portable equipment.

Equipment Standards

§ 183.510 Fuel tanks.

(a) Each fuel tank in a boat must have been tested by its manufacturer under § 183.580 and not leak.

(b) Each fuel tank must not leak if subjected to the fire test under § 183.590. Leakage is determined by the static pressure test under § 183.580, except that the test pressure must be at least one-fourth PSIG.

(c) Each fuel tank of less than 25 gallons capacity must not leak if tested under § 183.584.

(d) Each fuel tank with a capacity of 25 to 99 gallons must not leak if tested under § 183.586.

(e) Each fuel tank of 100 gallons capacity or more must not leak if tested under §§ 183.586 and 183.588.

§ 183.512 Fuel tanks: prohibited materials.

(a) A fuel tank must not be constructd from terneplate.

(b) Unless it has an inorganic sacrificial galvanic coating on the inside and outside of the tank, a fuel tank must not be constructed from black iron or carbon steel.

(c) A fuel tank encased in cellular plastic or in fiber reinforced plastic must not be constructed from a ferrous alloy.

§ 183.514 Fuel tanks: labels.

(a) Each fuel tank must have a label that meets the requirements of paragraphs (b) through (d) of this section.

(b) Each label required by paragraph (a) of this section must contain the following information:

(1) Fuel tank manufacturer's name (or logo) and address.

(2) Month (or lot number) and year of manufacture.

(3) Capacity in U.S. gallons.

(4) Material of construction.

(5) The pressure the tank is designed to withstand without leaking.

(6) Model number, if applicable.

(7) The statement, "This tank has been tested under 33 CFR 183.580."

(8) If the tank is tested under § 183.584 at less than 25g vertical accelerations the statement, "Must be installed aft of the boat's half length."

(c) Each letter and each number on a label must—

(1) Be at least $\frac{1}{8}$ inch high and

(2) Contrast with the basic color of the label or be embossed on the label.

(d) Each label must—

(1) Withstand the combined effects of exposure to water, oil, salt spray, direct sun light, heat, cold, and wear expected in normal operation of the boat, without loss of legibility; and

(2) Resist efforts to remove or alter the information on the label without leaving some obvious sign of such efforts.

§ 183.516 Cellular plastic used to encase fuel tanks.

(a) Cellular plastic used to encase metallic fuel tanks must—

(1) Not change volume by more than five percent or dissolve after being immersed in any of the following liquids for 24 hours at 29° C:

(i) Reference fuel B ASTM D-471, dated December 18, 1968.

(ii) No. 2 reference oil of ASTM D-471, dated December 18, 1968.

(iii) Five percent solution of trisodium phosphate in water; and

(2) Not absorb more than 0.12 pound of water per square foot of cut surface, measured under Military Specification MIL P-21929B, dated June 22, 1970.

(b) Non-polyurethane cellular plastic used to encase fuel tanks must have a compressive strength of at least 60 pounds per square inch at ten percent deflection measured under ASTM D-1621, "Compressive Strength of Rigid Cellular Plastics", dated August 31, 1964.

(c) Polyurethane cellular plastic used to encase fuel tanks must have a density of at least 3.2 pounds per cubic foot, measured under ASTM D-1622, "Apparent Density of Rigid Cellular Plastics", dated September 30, 1963.

§ 183.518 Fuel tank opening.

Each opening into the fuel tank must be at or above the topmost surface of the tank.

§ 183.520 Fuel tank systems.

(a) Each fuel tank must have a vent system that prevents pressure in the tank from exceeding 80 percent of the pressure marked on the tank label under § 183.514(b)(5).

(b) Each vent must—

(1) Have a flame arrester that can be cleaned unless the vent is itself a flame arrestor; and

(2) Not allow a fuel overflow at the rate of up to two gallons per minute to enter the boat.

§ 183.522 Fuel tank fill systems.

Fuel must not blow back through the fuel fitting when a tank is—

(a) Between one-fourth and three-fourths full; and

(b) Refueled at a rate of at least nine gallons per minute.

§ 183.524 Fuel pumps.

(a) Each diaphragm pump must not leak fuel from the pump if the primary diaphragm fails.

(b) Each electrically operated fuel pump must not operate except when the engine is operating or when the engine is started.

(c) If tested under § 183.590, a fuel pump must not leak fuel.

§ 183.526 Carburetors.

(a) If tested under § 183.590, a carburetor must meet the requirements of paragraph (b) of this section.

(b) Each carburetor must not leak more than five cubic centimeters of fuel in 30 seconds when—

(1) The float valve is open;

(2) The carburetor is at half throttle; and

(3) The engine is cranked without starting; or

(4) The fuel pump is delivering the maximum pressure specified by its manufacturer.

(c) Each updraft and horizontal draft carburetor must have a device that—

(1) Collects and holds fuel that flows out of the carburetor venturi section toward the air intake;

(2) Prevents collected fuel from being carried out of the carburetor assembly by the shock wave of a backfire or by reverse air flow; and

(3) Returns collected fuel to the engine induction system after the engine starts.

§ 183.528 Fuel stop valves.

(a) Each electrically operated fuel stop valve in a fuel line between the fuel tank and the engine must—

(1) Open electrically only when the ignition switch is on; and

(2) Operate manually.

(b) If tested under § 183.590, a fuel stop valve must not leak fuel.

§ 183.530 Spud, pipe, and hose fitting configuration.

Except when used for a tank fill line, each spud, pipe, or hose fitting used with hose clamps must have—

(a) A bead;

(b) A flare; or

(c) A series of annular grooves or serrations no less than 0.015 inches deep, except a continuous helical thread, knurl, or groove.

§ 183.532 Clips, straps, and hose clamps.

(a) Each clip, strap, and hose clamp must—

(1) Be made from a corrosion resistant material; and

(2) Not cut or abrade the fuel line.

(b) When tested under § 183.590, a clip, strap, or hose clamp must not separate under a one pound tensile force.

(c) The minimum nominal band width of a hose clamp is determined under Table 7 by the outside diameter of the hose.

TABLE 7

Outside hose diameter (inches):	Minimum nominal clamp band width (inches)
Less than ⅝	¼
⅝ to ¾	⅜
Greater than ¾ to 1½	½
Greater than 1½	⅝

§ 183.534 Fuel filters and strainers.

When tested under § 183.590, each fuel filter and strainer must not leak fuel from the filter, strainer, or its connections.

§ 183.536 Seals and gaskets in fuel filters and strainers.

(a) Each gasket and seal used in a fuel filter and strainer must form an unsplit ring.

(b) Each gasket and each sealed joint in a fuel filter and strainer must not leak when subjected for 24 hours to a gasoline that has at least a 50 percent aromatic content at the test pressure determined under § 183.582(a).

§ 183.538 Metallic fuel line materials.

Each metallic fuel line connecting the fuel tank with the fuel inlet connection on the engine must—

(a) be made of seamless annealed copper, nickel copper, or copper-nickel; and

(b) except for corrugated flexible fuel line, have a minimum wall thickness of 0.029 inches.

§ 183.540 Hoses: identification.

(a) Each "USCG Type A" hose and each "USCG Type B" hose must be identified by the manufacturer by a marking on the hose itself. If the complete text of the marking is not on a section of hose, the boat manufacturer must attach a tag that meets the requirements of paragraphs (b) and (c) of this section.

(b) Each marking and tag must contain the following information in English:

(1) The statement "USCG TYPE (insert A or B) HOSE."

(2) The year in which the hose was manufactured.

(3) The manufacturer's name or registered trademark.

(c) Each character must be block capital letters and numerals that are at least one-eighth inch high.

(d) Each marking must be permanent, legible, and on the outside of the hose at intervals of 12 inches or less.

§ 183.542 Fuel systems.

Each fuel system in a boat must have been tested under § 183.582 by the boat manufacturer and not leak.

MANUFACTURER REQUIREMENTS

§ 183.550 Fuel tanks: installation.

(a) Each fuel tank must not be integral with any boat structure or mounted on an engine.

(b) Each fuel tank must not move at the mounting surface more than one-fourth inch in any direction.

(c) Each fuel tank must not support a deck, bulkhead, or other structural component.

(d) Water must drain from the surface of each metallic fuel tank when the boat is in its static floating position.

(e) Each fuel tank support, chock, or strap that is not integral with a metallic fuel tank must be insulated from the tank surface by a nonmoisture absorbing material.

(f) Cellular plastic must not be the sole support for a metallic fuel tank.

(g) If cellular plastic is the sole support of a non-metallic fuel tank, the cellular plastic must meet the requirements of § 183.516 (b) or (c).

(h) Each fuel tank labeled under § 183.514(b)(8) for installation aft of the boat's half length must be installed with its center of gravity aft of the boat's half length.

§ 183.552 Plastic encased fuel tanks: installation.

(a) Each fuel tank encased in cellular plastic foam or in fiber reinforced plastic must have the connections, fittings, and labels accessible for inspection and maintenance.

(b) If a metallic fuel tank is encased in cellular plastic or in fiber reinforced plastic, water must not collect between the plastic and the surface of the tank or be held against the tank by capillary action.

(c) If the plastic is bonded to the surface of a metallic fuel tank, the adhesive strength of the metal to the plastic bond must exceed the cohesive strength of the plastic.

§ 183.554 Fittings, joints, and connections.

Each fuel system fitting, joint, and connection must be arranged so that it can be reached for inspection, removal, or maintenance without removal of permanent boat structure.

§ 183.556 Plugs and fittings.

(a) A fuel system must not have a fitting for draining fuel.

(b) A plug used to service the fuel filter or strainer must have a tapered pipe-thread or be a screw type fitted with a locking device other than a split lock washer.

§ 183.558 Hoses and connections.

(a) Each hose between the fuel pump and the carburetor must be "USCG Type A" hose.

(b) Each hose used for a vent line or fill line and each hose from the fuel tank to the fuel inlet connection on the engine must be—

(1) "USCG Type A" hose; or

(2) "USCG Type A" or "USCG Type B" hose, if no more than five ounces of fuel is discharged in 2½ minutes when—

(i) The hose is severed at the point where maximum drainage of fuel would occur,

(ii) The boat is in its static floating position, and

(iii) The fuel system is filled to the capacity marked on the tank label under § 183.514(b)(5).

(c) Each hose must be secured by—

(1) A swaged sleeve;

(2) A sleeve and threaded insert; or

(3) A hose clamp.

(d) The inside diameter of a hose must not exceed the actual minor outside diameter of the connecting spud, pipe, or fitting by more than the distance shown in Table 8.

TABLE 8

If minor outside diameter of the connecting spud, pipe, or fitting is—	The inside diameter of the hose must not exceed the minor outside diameter of the connecting spud, pipe, or hose fitting by more than the following distance:
Less than ⅜ in.	0.020 in.
⅜ in. to 1 in.	0.035 in.
Greater than 1 in.	0.065 in.

§ 183.560 Hose clamps: installation.

Each hose clamp on a hose from the fuel tank to the fuel inlet connection on the engine, a hose between the fuel pump and the carburetor, or a vent line must—

(a) Be used with hose designed for clamps;

(b) Be at least one clamp width from the hose end;

(c) Be beyond the bead, flare, or over the serrations of the mating spud, pipe, or hose fitting; and

(d) Not depend solely on the spring tension of the clamp for compressive force.

§ 183.562 Metallic fuel lines.

(a) Each metallic fuel line that is mounted to the boat structure must be connected to the engine by a flexible fuel line.

(b) Each metallic fuel line must be attached to the boat's structure within four inches of its connection to a flexible fuel line.

§ 183.564 Fuel tank fill system.

(a) Each fuel fill opening must be located so that a gasoline overflow of up to five gallons per minute for at least five seconds will not enter the boat when the boat is in its static floating position.

(b) Each hose in the tank fill system must be secured to a pipe, spud, or hose fitting by—

(1) A swaged sleeve;

(2) A sleeve and threaded insert; or

(3) Two adjacent metallic hose clamps that do not depend solely on the spring tension of the clamps for compressive force.

(c) Each hose clamp in the tank fill system must be used with a hose designed for clamps.

(d) Hose clamps used in the tank fill system must—

(1) Have a minimum nominal band width of at least one-half inch; and

(2) Be over the hose and the spud, pipe, or hose fitting and not less than one-half inch from the end of the hose.

§ 183.566 Fuel pumps: placement.

Each fuel pump must be on the engine it serves or within 12 inches of the en-

gine, unless it is a fuel pump used to transfer fuel between tanks.

§ 183.568 Anti-siphon protection.

Each fuel line from the fuel tank to the fuel inlet connection on the carburetor must—

(a) Be above the level of the tank top; or

(b) Have an anti-siphon device or an electrically operated fuel stop valve—

(i) at the tank withdrawal fitting; or

(ii) installed so the line from the fuel tank is above the top of the tank.

§ 183.570 Fuel filters and strainers: installation.

Each fuel filter and strainer must be supported on the engine or boat structure independent from its fuel line connections, unless the fuel filter or strainer is inside a fuel tank.

§ 183.572 Grounding.

Each metallic component of the fuel fill system and fuel tank which is in contact with fuel must be statically grounded so that the resistance between the ground and each metallic component of the fuel fill system and fuel tank is less than 100 ohms.

TESTS

§ 183.580 Static pressure test for fuel tanks.

A fuel tank is tested by performing the following procedures in the following order:

(a) Fill the tank with air or inert gas to the pressure marked on the tank label under § 183.514(b)(5). The pressure is measured by a calibrated pressure gauge with a pressure range not exceeding three times the test pressure required by this paragraph or by a manometer.

(b) Examine each tank fitting and seam for leaks using a leak detection method other than the pressure drop method.

§ 183.582 Static pressure test for fuel systems.

A fuel system is tested by performing the following procedures in the following order:

(a) Fill the portion of the system that is between the fuel line connection at the carburetor and the fill and vent fitting on the boat with air or inert gas to the greater of the following pressures:

(1) Three PSIG.

(2) One and one-half times the pressure created at the lowest point in the fuel system when the fill or vent line, whichever is lower in height, is filled to its top with fuel.

(b) Read the pressure. The pressure is measured by a calibrated pressure gauge with a pressure range not exceeding three times the test pressure required by this paragraph or by a manometer.

(c) Wait at least five minutes and thereafter wait one additional minute for each 10 gallon increment, or fraction thereof, in the tank's capacity greater than 50 gallons.

(d) Read the pressure in accordance with paragraph (b) of this section. A pressure drop measured at the end of the time required by paragraph (c) of this section is due to leakage.

(e) If no pressure drop is measured by the manometer or pressure gauge, then while the system remains pressurized, examine each fuel fitting, joint, and connection except each connection at fill and vent fittings for leaks, using a leak detection method other than the pressure drop method.

§ 183.584 Shock test.

A fuel tank is tested by performing the following procedures in the following order:

(a) Perform the static pressure test under § 183.580.

(b) If the tank is non-metallic, fill it to capacity with a gasoline that has at least a 50 percent aromatic content. Keep the fuel in the tank at 21° C or higher for 30 days prior to testing.

(c) Mount the tank to the platform of an impact test machine.

(d) Fill the tank to capacity with water.

(e) Apply one of the following accelerations within three inches of the center of the horizontal mounting surface of the tank. The duration of each vertical acceleration pulse is measured at the base of the shock envelope.

(1) If the tank is not labeled under § 183.514(b)(8) for installation aft of the half length of the boat, apply 1000 cycles of 25g vertical accelerations at a rate of 80 cycles or less per minute. The duration of the acceleration pulse must be between six and 14 milliseconds.

(2) If the tank is manufactured for installation with its center of gravity aft of the half length of the boat, apply 1000 cycles of 15g vertical accelerations at a rate of 80 cycles or less per minute. The duration of the shock pulse must be between six and 14 milliseconds.

(f) Perform the static pressure test under § 183.580.

§ 183.586 Pressure impulse test.

A fuel tank is tested by performing the following procedures in the following order:

(a) Perform the static pressure test under § 183.580.

(b) If the tank is non-metallic, fill it to capacity with a gasoline that has at least a 50 percent aromatic content. Keep the fuel in the tank at 21° C or higher for 30 days prior to testing.

(c) Mount the tank on a test platform.

(d) Fill the tank to capacity with water.

(e) Cap and seal each opening in the tank.

(f) Apply 25,000 cycles of pressure impulse at the rate of no more than 15 impulses per minute varying from zero to three PSIG to zero inside the tank top from a regulated source of air, inert gas, or water.

(g) Perform the static pressure test under § 183.580.

§ 183.588 Slosh test.

A fuel tank is tested by performing the following procedures in the following order:

(a) Perform the static pressure test under § 183.580.

(b) Perform the pressure impulse test under § 183.586.

(c) Secure the tank to the platform of a tank rocker assembly.

(d) Fill the tank to one-half capacity with water.

(e) Cap and seal each opening in the tank.

(f) Apply 500,000 cycles of rocking motion 15 degrees to each side of the tank centerline at the rate of 15 to 20 cycles a minute. The axis of rotation of the rocker and fuel tank must be perpendicular to the centerline of the tank length at a level six inches or less above or below the tank's bottom.

(g) Perform the static pressure test under § 183.580.

§ 183.590 Fire test.

(a) A piece of equipment is tested under the following conditions and procedures:

(1) Fuel stop valves, "USCG Type A" hoses, clips, straps, and hose clamps are tested in a fire chamber.

(2) Fuel filters, strainers, pumps, and carburetors are tested in a fire chamber or as installed on the engine.

(3) Fuel tanks must be tested filled with fuel to one-fourth the capacity marked on the tank in a fire chamber or in an actual or simulated hull section.

(b) Each fire test is conducted with free burning heptane and the component must be subjected to a flame for 2½ minutes.

(c) If the component is tested in a fire chamber—

(1) The temperature within one inch of the component must be at least 648°C sometime during the 2½ minute test;

(2) The surface of the heptane must be eight to 10 inches below the component being tested; and

(3) The heptane must be in a container that is large enough to permit the perimeter of the top surface of the heptane to extend beyond the vertical projection of the perimeter of the component being tested.

(d) If the component is being tested as installed on an engine, heptane sufficient to burn 2½ minutes must be poured over the component and allowed to run into a flat bottomed pan under the engine. The pan must be large enough to permit the perimeter of the top surface of the heptane to extend beyond the vertical projection of the perimeter of the engine.

(e) If a fuel tank is being tested in an actual or simulated hull section, the actual or simulated hull section must be of sufficient size to contain enough heptane to burn for 2½ minutes in a place adjacent to the tank.

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